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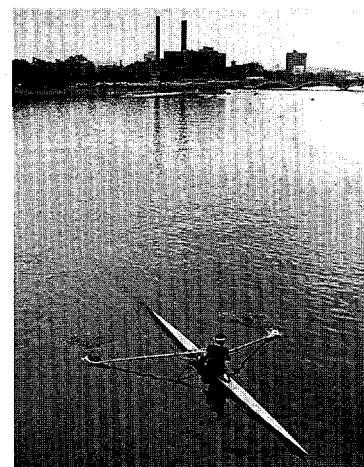
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# Report of the Southeastern New England Study



a Strategy for Balanced Development  
and Protection of Water and Related  
Land Resources in Eastern  
Massachusetts and Rhode Island

## 9. NARRAGANSETT BAY AND BLOCK ISLAND PLANNING AREA REPORT

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New England River Basins Comm.

The Southeastern New England Study (SENE) is a "level B water and related land resources study." It was conducted under the provisions of the federal Water Resources Planning Act of 1965. The resources management program the Study produced was developed by a team of federal, state, and regional officials, local citizens, and the scientific community, under the overall coordination of the New England River Basins Commission. It is a part of the Commission's comprehensive, coordinated joint plan for the water and related land resources of New England.

The recommended program for managing the resources of Southeastern New England is described, in increasing level of detail, in the following Final Reports:

A SUMMARY highlighting the principal findings and recommendations of the Study, and their implications for the future of the region.

A REGIONAL REPORT and Environmental Impact Statement describing *in detail* the natural resources, issues and problems facing the region, the alternative solutions examined during the Study, the recommendations made, and their implications. It includes policies and programs for dealing with water supply, land use, water quality, outdoor recreation, marine resources, flood and erosion protection, and key facilities siting, and the changes in state and local government required to implement the program.

Ten PLANNING AREA REPORTS dealing with the same subjects as the Regional Report, but aimed at the local level. Eastern Massachusetts and Rhode Island were divided into ten "planning areas" based either on traditional sub-state divisions or principal river basins. Reports were prepared for the following areas:

1. Ipswich-North Shore,
2. Boston Metropolitan,
3. South Shore,
4. Cape Cod and the Islands,
5. Buzzards Bay,
6. Taunton,
7. Blackstone and Vicinity,
8. Pawtuxet,
9. Narragansett Bay and Block Island,
10. Pawcatuck

Other reports prepared during the course of the Study include the following:

#### **Inventory Reports**

For each of the ten planning areas, inventory reports were prepared covering the following subjects: climate, meteorology, hydrology, geology; land use, patterns, allocations, and management; special environmental factors; water supply; ground water management; water quality control; outdoor recreation; fish and wildlife; navigation; flood plain zoning and streamflow management; inland wetlands management; coastal resources; irrigation and drainage; sediment and erosion; power; minerals.

#### **Special Reports**

In addition to inventory reports, over a dozen special reports were prepared, including: Socio-Economic and Environmental Base Study, Volumes I and II; Economic analyses of water supply and demand issues, power plant siting, coastal resources allocation, and sand and gravel mining; Legal and institutional analyses of the state wetlands laws, arrangements for water supply service, fiscal policy and land control, access to natural resources areas, and management structure for water and land use issues; Urban Waters Special Study; Summaries of public workshops


Copies of reports are available from:

New England River Basins Commission  
55 Court Street  
Boston, Massachusetts 02108

National Technical Information  
Service  
Springfield, Virginia 22151

and also in each of the 208 libraries and 210 town halls throughout the SENE region.





# Report of the Southeastern New England Study

a Strategy for Balanced Development  
and Protection of Water and Related  
Land Resources in Eastern  
Massachusetts and Provincetown

8. NARWAGAASSETT BAY AND BLOCK ISLAND  
PLANNING AREA REPORT

Prepared by the  
Southeastern New England  
Study  
with assistance from the  
Massachusetts Department of  
Environmental Affairs

# REPORT OF THE SOUTHEASTERN NEW ENGLAND STUDY

## READER'S GUIDE: HOW TO REVIEW THIS REPORT

- In five minutes

### FOR A "THUMBNAIL SKETCH"

Read the **OVERVIEW** which folds out as one large sheet. There is an extra copy in the pocket in the rear for those who would like to mount it on the wall.

- In a half hour or less

### TO LEARN THE MAIN POINTS

Read the **SUMMARY**. It is published separately. You can read it in either of two ways:

- **SELECTIVELY**. Read the Chapters on Goals and Approach and Guiding Growth, plus any others that interest you. Chapters are boldly labeled to facilitate selective reading; or
- **ENTIRELY**. Read the full summary for a fuller understanding of the highlights of the SENE Study.

- In one day or less

### TO UNDERSTAND THE DETAILS

Read the **REGIONAL REPORT**.

- **SELECTIVELY**. It is organized exactly like the summary. Wherever your interests lie, you can turn to those sections for additional background, amplifications, analysis of rejected alternatives, and especially for the full text of each recommendation, including who should do what and when. Also, remove the Development Capabilities Maps in the rear pocket and examine the legend to appreciate the type of information the maps portray; or
- **ENTIRELY**. Read the full report for full appreciation of all recommendations, and how they interrelate.

- In an additional 10 minutes to 2 hours

### FOR APPLICATION TO YOUR AREA

Get the **PLANNING AREA REPORT** for your locale. Scan it or read it to see how the broader recommendations presented in the Regional Report may apply to the area where you live or work.

# TABLE OF CONTENTS

## 9. Narragansett Bay and Block Island Planning Area Report

OVERVIEW . . . . .	v
PLANNING AREA ACTIONS MAP . . . . .	vii
CHAPTER 1 THEMES . . . . .	1-1
CHAPTER 2 THE SETTING . . . . .	2-1
CHAPTER 3 GUIDING GROWTH . . . . .	3-1
The Situation 3-1, Anticipated Growth 3-1, Accommodating Growth 3-2, Guiding Growth 3-3, <i>Critical Environmental Areas 3-3, Developable Areas 3-4, The Solutions 3-4, Priorities 3-7, Implications 3-7,</i>	
CHAPTER 4 WATER SUPPLY. . . . .	4-1
The Situation 4-1, The Solutions 4-1, Regional View in Meeting the Bay's Water Supply Problem 4-1, Existing and Proposed Resources and Opportunities 4-2, <i>Providence and Kent County Systems 4-2, Narragansett Bay Towns which will be Joining the Providence System, 4-3, Jamestown and Newport Water Systems 4-4, Water Supply in More Rural Parts of the Planning Area 4-5,</i>	
CHAPTER 5 WATER QUALITY . . . . .	5-1
The Situation 5-1, The Solutions 5-2, Preservation 5-2, Restoration 5-2, <i>Municipal Facilities 5-2,</i>	
CHAPTER 6 OUTDOOR RECREATION . . . . .	6-1
SWIMMING 6-1, RECREATIONAL BOATING 6-2, GENERAL OUTDOOR RECREATION 6-4, The Narragansett Bay Islands Park 6-4, Block Island 6-5, Additional Alternative Solutions 6-6, Additional Recommendations 6-6, WILDLIFE AND FRESH WATER FISHERIES 6-7, ALTERNATIVE MEASURES 6-7, RECOMMENDATIONS 6-8, ANADROMOUS FISH RESTORATION 6-9, Implications 6-9,	
CHAPTER 7 MARINE MANAGEMENT . . . . .	7-1
COMMERCIAL NAVIGATION IN THE BAY 7-1, SHELLFISH 7-2, OFFSHORE FISHERIES 7-3, OFFSHORE SAND AND GRAVEL 7-5, URBAN WATERFRONTS 7-5,	
CHAPTER 8 FLOODING AND EROSION . . . . .	8-1
The Situation 8-1, Inland Flooding 8-1, Coastal Flooding 8-1, Upland and Coastal Erosion 8-2, <i>Upland Erosion 8-2, Coastal Erosion 8-2, The Solutions 8-3, Recommendations 8-3, Implications 8-4,</i>	
CHAPTER 9 LOCATING KEY FACILITIES. . . . .	9-1
SAND AND GRAVEL MINING 9-1, POWER GENERATION AND POWER PLANT SITING 9-1, PETROLEUM REFINING, DISTRIBUTION, AND STORAGE 9-2, SOLID WASTE MANAGEMENT 9-2,	

## OVERVIEW

### Narragansett Bay and Block Island Planning Area

#### What is the point of the SENE Study program?

Balanced use and conservation of the region's water and related land resources is the program's objective. The Southeastern New England (SENE) Water and Related Land Resources Study was authorized and funded by Congress in response to the increasingly troublesome pressures the region's rapid urbanization was exerting on its rich and varied natural resources. The SENE Study had two major goals:

- To recommend actions for all levels of government and private interests to secure for the people of the region the full range of uses and benefits which may be provided by balanced use and conservation of the region's water and related lands.
- To assemble information on the resources at a consistent scale and level of detail.

What makes this Study different is that it covers a relatively large geographic area (4400 square miles), it addresses a full range of water and related land issues, and it proposes coordinated actions for all levels of government and private interests.

#### What does the SENE Study program cover?

The most important recommendations for this planning area include the following:

- (1) To accommodate growth in environmentally and economically acceptable ways, municipalities should prohibit or restrict development on Critical Environmental Areas such as wetlands, flood plains, and well sites. Growth should be guided to Developable Areas which cover 34 percent of the planning area. Within this category, municipalities should manage development on resources such as steep slopes, ledge, and soils with septic limitations. Development should be encouraged where services already exist or are planned.
- (2) To provide sufficient amounts of public water supply, protect and to some extent redistribute existing resources and obtain additional supplies from outside the planning area. These supplies would come from the Providence water supply system, if it manages the Big River Reservoir.
- (3) To maintain and improve the quality of Bay area waters, provide secondary levels of treatment at municipal facilities, and separation or treatment of some combined sewers.

- (4) To meet recreation needs, establish a Narragansett Bay Islands Park, expand existing facilities (including boating facilities) throughout the planning area, improve transportation and access to recreation areas, and acquire new areas, especially near urban centers.
- (5) To develop renewable and non-renewable marine resources in an ecologically and economically sensitive manner, offshore fishing activities should be limited within a 200-mile zone. The fishing industry should be supported through a national fisheries management policy, improved market for underutilized species, and improved support services. To maintain shellfish habitats and populations, license recreational fishermen and correct Providence water quality problems. Navigation channels should be improved at several harbors, and guidelines established for operation of the liquified natural gas (LNG) complex.
- (6) To reduce flood damages, prohibit new development in the inland and coastal flood plains through local zoning; encourage non-structural flood plain management measures wherever possible.
- (7) To provide vital energy services, site needed facilities according to regional policy now being developed. Avoid Critical Environmental Areas when considering power plant sites, and reduce power needs. To meet future sand and gravel needs, make onshore mining environmentally acceptable through a state and local system of sequential land uses and operating regulations.

#### What will the program do?

If the recommended actions are carried out, most 1990 needs for water, sewers, electric power, and outdoor recreation could be met by making more efficient use of existing facilities, legal authorities, and institutional designs. Protecting Critical Environmental Areas will avoid potential dangers to life and property from flooding, erosion, and contamination of water quality; and will provide highly productive greenbelts. As a result, new growth in this planning area can be accommodated without harming the high quality environment which attracted the growth in the first place.

You can take the first step in helping to carry out the program by reading the recommendations in the SENE Study's Regional and Planning Area Reports. Write your state and Congressional representatives about the Study. Urge your local planning and conservation officials to use the SENE planning process when developing or implementing master plans, zoning ordinances such as flood plain and watershed protection, and other water and land use decisions.

## RECOMMENDATIONS

### GUIDING GROWTH (Chapter 3)

1. Protect priority Critical Environmental Areas.
2. Restrict development on other Critical Environmental Areas.
3. Manage growth on Developable Areas.
4. Use SENE resource development capability analysis to guide future growth.
5. Accommodate growth where services already exist.

### WATER SUPPLY (Chapter 4)

1. Extend Providence Water Supply Board service to Warwick.
2. Continue ground water exploration in East Greenwich.
3. Extend Providence Water Supply Board service to Barrington, Bristol, and Warren.
4. Begin an intensive watershed control program for the Jamestown system.
5. Maintain existing resources, with long-term reliance on the Big River Reservoir, in four lower Narragansett Bay communities.
6. Ensure efficient reallocation of U. S. Navy base water supplies in Newport.
7. Rely on local ground water in Narragansett, New Shoreham, North Kingstown, and Rehoboth.
8. Construct two offstream reservoirs in Swansea.
9. Consolidate North Tiverton and Stone Bridge Fire Districts.
10. Set streamflow depletion standards near North Kingstown's wells.

### WATER QUALITY (Chapter 5)

1. Construct a secondary wastewater treatment facility in New Shoreham.
2. Construct a secondary wastewater treatment facility in Narragansett.
3. Serve Barrington by the East Providence treatment facility.
4. Upgrade the Newport treatment facility to secondary.
5. Continue partial separation of combined sewers in conjunction with treatment techniques.
6. Continue to serve Warwick by a secondary treatment facility.
7. Construct a secondary treatment facility in Jamestown.
8. Serve northern Tiverton by the Fall River treatment facility.
9. Serve Swansea by the Somerset facility.
10. Expand Quonset Point plant to serve North Kingstown and a portion of Warwick.
11. Upgrade Bristol plant to secondary treatment and serve Warren.
12. Abandon Scarborough Hills facility and connect to Narragansett regional facility.

### OUTDOOR RECREATION (Chapter 6)

#### Swimming

1. Continue weekend bus service from Providence to beaches.
2. Acquire a new public beach in Warwick.
3. Acquire nearly a mile of public beach in North Kingstown.
4. Acquire local beaches in Portsmouth, Jamestown, and North Kingstown.
5. Secure public access to the shoreline.

#### Recreational Boating

6. Construct authorized project at Bristol Harbor.
7. Maintain 14 existing navigation channels.
8. Develop 2 new navigation channels and a boat landing.
9. Guide future development of marinas in 22 localities.
10. Investigate new regional harbors in Narragansett Bay.

### General Outdoor Recreation

11. Develop Narragansett Bay Islands Park.
12. Develop Block Island for recreation.
13. Develop area around Hundred Acre Cove and Runnin's River.
14. Develop urban parks along Warwick's coast.
15. Protect Pettaquamscutt River Corridor for low-intensity recreation and conservation.
16. Acquire access to Secret Lake and Kettle Hold Pond.
17. Use SENE Development Capabilities Maps for open space protection.

### Fish and Wildlife

18. Provide assistance to municipalities for enforcing wetlands legislation.
19. Acquire public access to ponds with high potential for fisheries production.
20. Acquire significant wildlife wetlands.
21. Acquire public access to 5 streams.
22. Improve anadromous fish stocks.

### MARINE MANAGEMENT (Chapter 7)

#### Port Development

1. Complete Fall River channel as soon as suitable disposal sites are approved.
2. Complete Providence Channel.
3. Develop channel improvements for Newport and Port Judith fishing industry.
4. Develop rigid operational guidelines for LNG and oil development.

#### Shellfish

5. Consider recreational shellfish licensing.
6. Eliminate combined sewer overflows in Providence.

#### Offshore Fisheries

7. Continue to support an interim offshore 200-mile economic zone.
8. Support national fisheries management policy.
9. Improve market for underutilized fish species.
10. Accommodate coastal fish facilities through improved planning.
11. Allow privately financed purchase of foreign-built fishing vessels.

#### Urban Waterfronts

12. Coordinate local waterfront planning and development.
13. Provide public waterfront vantage points.
14. Provide guidance and set criteria at the state level for priority waterfront uses.
15. Review and coordinate waterfront use.
16. Provide federal funding for state and local waterfront development plans.

### FLOODING AND EROSION (Chapter 8)

1. Develop flood plain management programs which maximize non-structural solutions.
2. Adopt local flood plain zoning preventing adverse flood plain development.
3. Establish local sediment and erosion control ordinances.
4. Establish forest buffer zones.
5. Establish local regulations to strengthen flood plain management.
6. Acquire significant flood plains and wetlands.
7. Locate in existing safe buildings in the flood plain.
8. Encourage natural stabilization of coastal erosion areas.

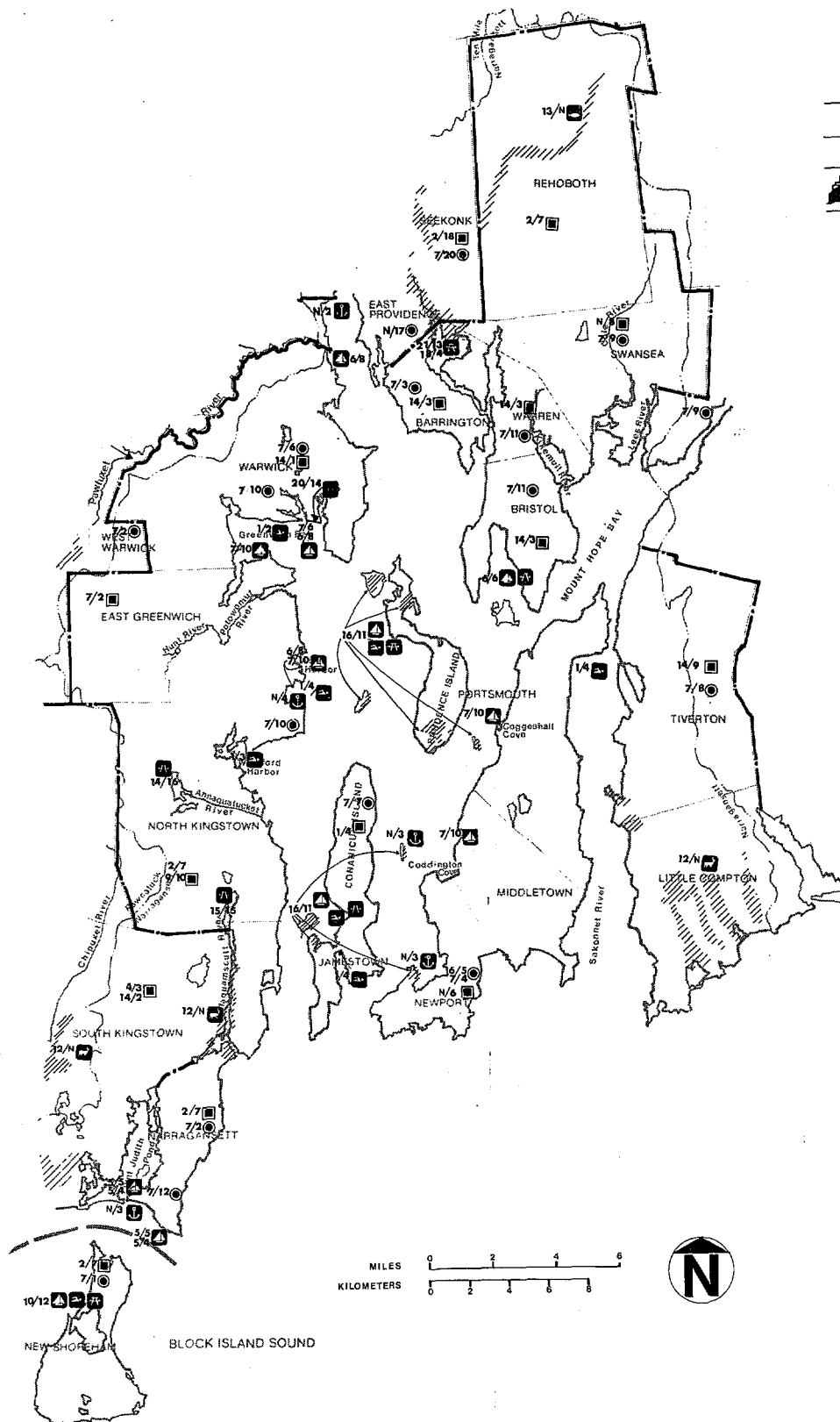
### LOCATING KEY FACILITIES (Chapter 9)

See Regional Report, Chapter 9

The symbols on this map represent the recommended actions that can be shown on a town-by-town basis. The symbols are placed roughly within each town, and are not intended to be more specifically sited than that.

## Legend

	WATER SUPPLY
	WATER QUALITY
<b>RECREATION</b>	
	Swimming & Public beaches
	Boating & marinas
	Fisheries & wildlife
	Other recreational activities
<b>MARINE MANAGEMENT</b>	
	FLOODING & EROSION CONTROL
<b>KEY FACILITIES</b>	
	NUMERICAL NOTATION
12/4	
Planning Area Report recommendation number	
Regional Report recommendation number	
(N signifies no corresponding recommendation)	



NEW ENGLAND RIVER BASINS COMMISSION  
BOSTON, MASSACHUSETTS

SOUTHEASTERN NEW ENGLAND  
WATER AND RELATED LAND RESOURCES STUDY



Narragansett Bay Planning Area  
Recommended Actions



# CHAPTER 1 THEMES

This report on the Narragansett Bay and Block Island planning area is one component of a comprehensive program for managing water and related land resources in the Southeastern New England (SENE) region. The Study's Regional Report has presented recommended policies and actions from a regionwide or statewide perspective. This Planning Area Report includes applications of those broad-based recommendations to the cities and towns in the Narragansett Bay area.

One reason for preparing Planning Area Reports is to connect the actions at the local level with the policy framework and considerations for state and federal levels. This direction was chosen as a response to the region's long history of local autonomy and to the Study's emphasis on placing decision-making at the level commensurate with the anticipated scope of the decision. The planning area boundaries follow town lines most closely approximating the hydrologic boundaries of river basins.

Three common themes link all the reports.

- **Enhancing the environment enhances the economy.** This relationship is especially clear in the Narragansett Bay area. The beauty of the Bay and its shoreline plus the quality of its waters are important factors for tourism, recreation, and fishing.
- **Anticipated growth can be accommodated, but it needs guidance.** The SENE Study represents a strong beginning. New growth will have to be carefully guided to avoid adverse impacts on the Bay area's valuable shoreline and Critical Environmental Areas.
- **Existing knowledge, programs and institutions provide the most realistic tools for achieving results, but some changes are needed.** Full use

of ongoing programs, with some changes in how they relate to each other, was viewed as a way of "piggy-backing" on programs which already have weathered most of the realities of the political process. In choosing this strategy, the Study traded off novelty to increase achievability.

Each major chapter in this report contains actions to solve water and related land problems which we face now or can expect to face in the next 15 years and in some cases into the next century. Table 1.1 sets out the intensity of these problems within each planning area, between them, and for the region as a whole. While none of the seven resource subject areas were judged severe problems (as shown in Table 1.1), almost all were considered major:

- **Guiding Growth.** Many critical environmental resources and valuable shoreline resources leave only limited land suitable for development in terms of expected growth.
- **Water Quality.** Urban runoff is a major problem in the Upper Bay; municipal discharges, oil pollution, and watercraft wastes also seriously threaten the Bay's water quality.
- **Water Supply.** The existing water supply systems cannot satisfy future demands.
- **Marine Management.** Port development and maintaining strong offshore fisheries have important impacts on both the area's economy and the coastline.
- **Flooding and Erosion.** With its long shoreline exposed to severe storms, the area is particularly susceptible to coastal flooding and storm damage.
- **Locating Key Facilities.** The Bay's protected channels and long shoreline make it a prime candidate for power plants and petroleum related facilities.

**TABLE 1.1 GENERAL INTENSITY OF SENE WATER - RELATED PROBLEMS BY PLANNING AREA**

Key  ● Severe problem ○ Major problem • Moderate problem  Blank Minor or no problem	GUIDING GROWTH (Overall)															
	Protection of Critical Environmental Areas				Management of Developable Areas				Land Use Discharges							
	WATER SUPPLY				WATER QUALITY (Overall)				Combined Sewers/Urban-Runoff							
	Municipal Discharges				Industrial Discharges				Low Streamflow							
	Septic Systems				Agricultural Runoff				Landfill Leachate							
	Oil Pollution				Watercraft Wastes				RECREATION (Overall)							
	Swimming				Boating				Recreational Saltwater Fishing							
	Camping and Picnicking				Access to Hunting and Fishing Opportunities				Passive Outdoor Recreation							
	MARINE MANAGEMENT (Overall)				Offshore Fisheries				Shellfish and Aquaculture							
	Port Development				Offshore Sand and Gravel				Urban Waterfronts							
FLOODING AND EROSION (Overall)																
Inland Flooding				Coastal Flooding				Inland Erosion								
Coastal Erosion				LOCATING KEY FACILITIES (Overall)				Availability of Sand and Gravel								
Power Plant Siting				Petroleum Facilities Siting				Solid Waste Management								

PLANNING AREAS																
Ipswich - North Shore	●	○	●	○	●	○	●	○	●	○	●	○	●	○	●	○
Boston Metropolitan	●	○	○	○	●	○	●	○	●	○	●	○	●	○	●	○
South Shore	○	●	○	●	○	●	○	●	○	●	○	●	○	●	○	●
Cape Cod and the Islands	○	●	●	●	○	●	○	●	○	●	○	●	○	●	○	●
Buzzards Bay	●	●	●	●	○	●	○	●	○	●	○	●	○	●	○	●
Taunton	○	●	●	●	○	●	○	●	○	●	○	●	○	●	○	●
Blackstone and Vicinity	●	●	●	●	○	●	○	●	○	●	○	●	○	●	○	●
Pawtuxet	○	●	●	●	○	●	○	●	○	●	○	●	○	●	○	●
Narragansett Bay	○	●	●	○	●	○	●	○	●	○	●	○	●	○	●	○
Pawcatuck	●	○	●	○	●	○	●	○	●	○	●	○	●	○	●	○
REGION AS A WHOLE	●	○	○	○	●	○	●	○	●	○	●	○	●	○	●	○

## CHAPTER 2 THE SETTING

The Narragansett Bay and Islands planning area consists generally of the land that drains into the Narragansett Bay and the islands in the Bay, plus Block Island. The specific boundaries follow town lines and are shown earlier. The area covers roughly 212,000 acres (about 331 square miles) and 16 cities and towns, from Narragansett north to Warwick and Barrington (including Rehoboth and Swansea in Massachusetts) and south to Little Compton:

Barrington	Middletown	Rehoboth
Bristol	Narragansett	Swansea
East Greenwich	Newport	Tiverton
Jamestown	New Shoreham	Warren
Little Compton	North Kingstown	Warwick
	Portsmouth	

Although Warwick is included in this planning area, flooding problems along the Pawtuxet River portion of this town are discussed in *Chapter 8 of the Pawtuxet Planning Area Report*.

In the seaboard lowland section, characterized as an irregular surface with maximum elevations less than 500 feet, the Narragansett Bay planning area surface and landform is largely the result of glacial erosion and deposition. Over 50 coastal streams, whose basins range in size from 0.8 to 21.6 square miles, and direct tributaries to the Bay. The flat relief of most of the basins provides extensive flood plains and wetlands.

Three major islands — Aquidneck, Conanicut, and Prudence — divide the Bay into three channels which serve as important transportation routes. Over two dozen islands in the planning area range in size from 0.1 to 22,000 acres.

The shoreline of the Bay planning area, including that of the larger islands, is approximately 288 miles in length. Many tidal coves and estuaries make up the irregular coastline. Sand and gravel bluffs comprise the greater part of the coast, but sandy beaches, rocky headlands, tidal marshes, and mudflats are also common. Other coastal features include man-made bulkheads, walls, and revetments. Eighteen miles of public beaches provide recreation opportunities, not only for residents of the Narragansett Bay area, but for those of other regions as well.

In this maritime climate, precipitation is high, averaging 43 inches, rather evenly distributed throughout the year. About half of this rainfall evaporates or transpires to the atmosphere through vegetation. The remaining half flows through the area's rivers and streams either directly as overland runoff or indirectly as ground water seepage.

Only about 5 percent of the people in the SENE region live in this planning area. Its population has been rising rapidly, however, from 231,000 in 1960 to 291,000 by 1970. This represents a rate of growth over the ten-year period of over 26 percent, or three times the overall rate of the region's growth for the same period. With the exception of Block Island, every town or city grew by at least 20 percent. According to Study projections, population will climb to 384,000 by 1990, and 553,000 by 2020. This anticipated growth is about twice that of the SENE average, and a little less than twice the expected average growth for the United States as a whole. Within the planning area, however, the population is not so stable. Absolute growth between 1960 and 1970 has been relatively high in Middletown, North Kingstown, and Warwick, but declined in the Newport area. The 1972 Naval base closings brought significant population decreases in both the North Kingstown and Newport (and Middletown) areas.

Per capita income in 1969 was approximately \$3100 (1967 dollars) for the coastal Rhode Island area (excluding the Providence-Pawtucket-Warwick area). This is one of the lower income levels in the SENE region and is 8 percent below the national average. With a 1970 work force of nearly 70,000, the area represents less than 5 percent of the workers in SENE. Based on 1970 data, the area was heavily dependent on the government sector for nearly 30 percent of its jobs. Other important sectors are manufacturing, retail, and other services. During the 1960's, 14,000 new jobs were added. Most of these were in the manufacturing and retail sectors. Jobs in the government sector declined over 10 percent, and have declined even more since 1970.

Early in the Study, participants at public workshops expressed a preference for a long-range water use policy before deciding on new supplies, treatment of Providence sewer overflows as a priority for improving water quality in the Bay, stronger enforcement of wetlands legislation, and expanding water related recreation opportunities together with improving Bay water quality.

Later, during the 90-day review period, over 275 state, regional, and municipal officials, federal agencies, and concerned citizens submitted comments on the Study's draft reports. The major comments are summarized in a Regional Report chapter, "*Review of the Report*."

Several major changes were made in the Narragansett Bay Planning Area Report. Concerned residents and the Kicke-muit River Council noted errors in Development Capabilities Maps; as a result, *Chapter 3* discusses the corrections and the maps now have a note of caution about appropriate

uses. In response to the Providence Water Supply Board, the recommendation concerning water supplies for Barrington, Bristol, and Warren has been updated to reflect that existing sources will be supplemented by water from the Providence system, rather than switching completely to the Providence system. *Chapter 6* recommends that the City of Warwick, not the Department of Natural Resources, acquire and manage a local beach as currently planned by the City. Also, low-intensity recreation is specified for the Pettaquamscutt and Kickemuit River corridors because of the numerous Critical Environmental Areas. *Chapter 7* includes a new recommendation for improved public access to urban waterfronts in response to concerns expressed by residents in the greater Providence metropolitan area.

Several implications stand out from the preceding profile:

- (1) While not the fastest growing area, the planning area had the largest absolute population growth in Rhode Island (the second largest in the SENE re-

gion during the 1960's), putting development pressure on both land and water resources.

- (2) Water quality problems in parts of the Bay are severe, especially in the Providence and Mount Hope Bay areas, yet the southern portion of the Bay has generally clean water.
- (3) Limited ground water sources mean the planning area must look to other sources for adequate supplies.
- (4) The Bay is a recreation resource of regional importance, and opportunities are good for further recreation development.
- (5) The area's long shoreline, deep protected channels, and abundance of cooling water make the planning area a prime target for future power plants and petroleum refining facilities. Yet significant siting conflicts exist.

## CHAPTER 3 GUIDING GROWTH

Between 1960 and 1970, the face of the Narragansett Bay planning area changed noticeably as lands in urban uses increased from roughly 28,000 acres to 53,000 acres — a nearly 90 percent increase in “urbanized” lands. At the same time, as much as 25 percent of the area’s agricultural lands were lost; forested and open lands declined, although to a lesser extent than agricultural lands. Yet the planning area still has the highest proportion of agricultural lands of all the planning areas in the SENE region. Some 25 percent of the planning area is in agricultural use, twice the average for the region. Urban uses now account for another 25 percent, and forested, open lands, and water make up the other 50 percent of the area’s 212,000 land and water acres.

This shift away from agricultural to urban uses was accompanied by a 25 percent increase in population, and an increase in population density of 27 percent, from an average density of 1.1 to 1.4 persons per acre. The Study’s projections indicate a population growth of another 32 percent by 1990 and 90 percent for the period from 1970 to 2020 — close to twice the 1970 population.

There is a growing concern among the planning area’s residents about finding ways to locate new development where it will lessen the impact on the area’s land and water resources. *Chapter 2 of the Regional Report* has shown that these resources are major components of an environmental quality which is a major factor in the region’s economic vitality. The Study has concluded that if certain planning steps are taken, anticipated growth in the region can be accommodated while maintaining the existing quality of life. But the Narragansett Bay planning area has a much smaller share than the region as a whole of developable lands relative to expected growth. This chapter describes the nature of growth that is expected, and the ability of the resources to accommodate new development. It concludes with

strategies recommended to guide growth which are sensitive to both economic and environmental considerations.

### The Situation

#### Anticipated Growth

As previously mentioned, the population of the Narragansett Bay planning area is expected to grow by 32 percent by 1990, and by a total of 90 percent by 2020. These projected increases make the area one of the fastest growing in the region, following the South Shore, Cape Cod, and Pawtuxet planning areas. Assuming that existing rates of land consumption will apply to these population increases, 38,700 acres could be needed to accommodate the additional population by 1990, and a total of 109,200 acres by 2020, or over half again as much as the planning area’s estimated remaining 71,000 developable acres (discussed in section on Guiding Growth, below).

The rates at which parts of the planning area will be urbanized will vary to some extent with relative development pressures. These pressures were estimated for SENE communities on the basis of a formula using factors such as the rate of growth of residential, commercial, and other uses, the relative accessibility of an area of employment and population in other parts of the region, and the availability of easily developable land. The process for grouping towns by development pressure is defined in *Chapter 3 in the Regional Report*. While use of other factors, such as recent building permits or land consumption rates, may produce different results, combining the factors used gives some useful indication of development pressure in the communities in the planning area, relative to all SENE communities. Table 3.1 shows the development pressure for the planning area cities and towns.

TABLE 3.1 MUNICIPALITY BY DEVELOPMENT PRESSURE: NARRAGANSETT BAY PLANNING AREA

High	Medium High	Medium Low	Low
Narragansett	East Greenwich	Barrington	Bristol
North Kingstown	Rehoboth, Mass.	Tiverton	Jamestown
Portsmouth	Swansea, Mass.	Middletown	Little Compton
Warwick		Warren	Newport
			New Shoreham

Note: Communities are grouped into levels of development pressure relative to other communities in the Study region and do not necessarily reflect local building activity.

## Accommodating Growth

It is expected that almost all of the growth in the next 20 to 50 years will occur on land not yet developed. As previously mentioned, 25 percent or 53,000 acres of the planning area's land was in urban uses in 1970. Of that amount, 7,000 acres were in medium intensity residential use of ½ to 1 acre, and another 5,000 acres were in low-intensity residential use of over 1 acre per unit. This means that some 41,000 acres were in high-intensity urban uses such as commercial, residential or multi- and single-family units on less than ½ acre lots, public institutions, industrial, or transportation.

Forested, open, agricultural, and water uses account for the 75 percent of Bay area not urbanized as of 1970. In order to assess the implications of growth for these resources, the Study first identified and quantified them. Classified according to development capability, these resources are grouped into three major categories, as shown in Table 3.2.

Two of these categories represent Critical Environmental Areas: Priority Protection (Category A) and Other Protection (Category B) Areas. The first category includes water bodies, wetlands, beaches, and critical coastal erosion areas. Insensitive use of these critical resources threatens health, safety, and welfare. Category B resources include those whose development will result in significant environmental, economic, and social costs. These somewhat less fragile resources are flood plains, prime agricultural soils, unique natural and cultural sites, upland erosion areas, and proposed reservoir sites and related watersheds. On Developable Areas, Category C, F, and G resources — recharge areas for high yield aquifers, best upland wildlife habitat, high landscape quality areas, ledge and/or steep slopes, and soils with severe or moderate septic limitations — development is compatible if it is carefully carried out so as not to damage intrinsic qualities. Existing development (Category E) and publicly owned lands (Category D) have for the most part preempted additional use.

TABLE 3.2 THE SENE RESOURCE DEVELOPMENT CAPABILITY SYSTEM

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### CRITICAL ENVIRONMENTAL AREAS REQUIRING PROTECTION

Water Bodies (Category A), blue. [Includes estuaries, shellfish flats, and fish spawning areas.]

Priority Protection Areas (Category A), dark green: wetlands, well sites, beaches, and critical coastal erosion areas.

Other Protection Areas (Category B), light green: flood plains, class I and II agricultural soils, unique natural and cultural sites, [proposed reservoir sites and related watersheds, and upland erosion areas] excluding all "A" areas.

### DEVELOPABLE AREAS REQUIRING MANAGEMENT, Excluding All A & B Areas

#### WATER RESOURCE LIMITATIONS

Aquifers and/or Recharge Areas (Category C<sub>1</sub>) black dots: highest yield aquifers in each basin.

#### WILDLIFE AND SCENIC RESOURCE LIMITATIONS

Wildlife Habitat (Category C<sub>3</sub>), black diagonal lines: best upland wildlife habitat other than publicly owned land and [commercial fishing grounds].

Landscape Quality Areas (Category C<sub>2</sub>), black vertical lines: land characterized by high landscape quality other than categories C<sub>1</sub> and C<sub>3</sub>.

#### SOILS RESOURCE LIMITATIONS

Ledge and/or Steep Slope (Category C<sub>5</sub>), brown: land with slope greater than 15 percent and/or with rock near the surface.

Severe Septic System Limitations (Category C<sub>4</sub>), orange: land with severe septic system limitations other than Category C<sub>5</sub>.

Moderate to No Septic System Limitations (Categories F and G), yellow: land with moderate or no septic system limitations.

### PREEMPTED USE AREAS

Urban Areas (Category E), gray: residential<sup>5/</sup>, institutional, commercial and industrial development.

Publicly Owned Lands (Category D), beige: major public parks, forests, watersheds, and military lands.

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#### Notes:

- 1/ All categories above, except those within brackets, are depicted on the development capabilities maps (plates 1, 2, 3).
- 2/ Categories in brackets are included to show where they would fit in the overall classification hierarchy, were they included on the plates in the pocket.
- 3/ All categories above, including those within brackets, are depicted on large-scale, unpublished maps available for inspection as part of the SENE Files.
- 4/ Categories C<sub>1</sub>, C<sub>2</sub> and C<sub>3</sub> overlap with categories C<sub>4</sub>, C<sub>5</sub>, F, or G. Thus, Category C<sub>3</sub>-C<sub>4</sub> is a wildlife habitat located on ledge or steep slopes.
- 5/ Mapped urban areas (Category E) include all-residential development, although the legend on Plates 1, 2, and 3 reads "residential areas on less than one acre lots."

But it is worth noting that developed areas can be used — and further, that use and reuse of such land can be highly efficient.

These land and water resources of the Narragansett Bay planning area have been mapped on Plate 3; the percent of the planning area in each category is displayed on Table 3.3.

As mentioned earlier in this chapter, about 25 percent of the planning area has already been developed (in “urban” use). Warwick, North Kingstown, and Newport account for most of the existing urbanized land. These urbanized areas embrace an infrastructure including wastewater systems which serve 25 percent of the total planning area population. Another 9 percent of the planning area is publicly owned. This figure includes over 2,000 acres of former Navy land now available for reuse for commercial, industrial, residential, and in some cases recreational purposes. Key amounts of these lands are in North Kingstown, Newport, Middletown, and Portsmouth. These combined amounts of urbanized and publicly owned lands, which total some 34 percent of the planning area, are nearly the same share as for the SENE region (33 percent).

### Guiding Growth

**Critical Environmental Areas (Categories A and B)** (see Plate 3) comprise nearly one-third of the planning area,

the same percentage as that for the entire SENE region. The diversity of these resources contributes significantly to the rich environmental quality of the Bay area.

**Priority Protection Areas, Category A resources** cover about 16 percent of the planning area. Wetlands, for example, are abundant, particularly in Rehoboth, Tiverton, Little Compton, and Swansea. Wetlands are prime targets for development. Between 1960 and 1970, 33 percent of the planning area’s salt water wetlands were lost. *Chapters 6 and 8 of this and the Regional Report* discuss the value of wetlands for flood storage, water supply, plant and wildlife habitat, erosion control, and other purposes.

Another 16 percent of the planning area is covered by **Other Protection Areas, Category B resources**, not already included in A resources (some 21,000 acres of each, for a total of over 42,000 acres subject to flooding, or 20 percent of the planning area). Development in some of these flood plains has aggravated flooding and storm damage problems (see *Chapter 8*). Prime agricultural lands are plentiful in this area but are major targets for development. The highest losses of these in the planning area were in Rehoboth, Bristol, Portsmouth, Tiverton, and North Kingstown. *Chapter 3 of the Regional Report* discusses the significance of these losses. The planning area is rich in unique historical sites, many of which are in the Newport area; archaeological and natural sites throughout the planning area total over 14,600 acres.

**TABLE 3.3 PERCENT OF LAND AND WATER RESOURCE CATEGORIES IN EACH PLANNING AREA**

Planning Area	Total (in 1000's of acres)	Percent (%) of Planning Area				
		Critical Environmental Areas			Develop- able Areas	Preempted Use Areas
		A	B	A & B	C, F, G	D, E
Ipswich-North Shore	274	19	13	32	34	34
Boston Metropolitan	421	14	9	23	30	47
South Shore	172	17	13	30	43	27
Cape Cod & Islands	378	10	23	33	32	35
Buzzards Bay	205	17	16	33	47	20
Taunton	351	19	22	41	37	22
Blackstone & Vicinity	410	10	11	21	38	41
Pawtuxet	180	11	7	18	41	41
Narragansett Bay	212	16	16	32	34	34
Pawcatuck	262	27	12	39	40	21
SENE	2,865	16%	15%	31%	36%	33%

Sources: See Methodology in the Regional Report.

**Developable areas**, Categories C, F, and G (mapped on Plate 3) make up some 34 percent of the planning area. A large proportion — over 20 percent — of the land has been classified as having high landscape quality (defined by diversity and relief). Development of slopes of over 15 percent causes risk of erosion and septic system seepage to areas below. Areas which are predominantly ledge — either exposed or within three feet of the surface — offer little development potential despite their physical attractiveness and aesthetic quality. Density of development on soils with severe septic tank limitations (an estimated 16,000 acres in the planning area) must be regulated according to availability of sewers. Developable areas also include soils with moderate to no septic limitations.

The question is, how much of the expected increase in population could be accommodated on developable lands in the planning area. During the 1960's, the land consumption rate for the Bay area was just over 0.4 acre for each additional person, under the regional average of 0.5 per additional person. Assuming that the same rate of land consumption (0.4 acre per additional person) will hold for the future, 170,400 persons could be accommodated on planning area C, F, and G lands. This is more than the anticipated increase of 93,000 people by 1990, but considerably less than the expected increase of 263,000 more people by 2020. Should the land consumption rate be at the regional rate, approximately 143,000 persons could be accommodated. While this figure is less than at the previous rate, it still puts the planning area in the middle; projected increases in population can be accommodated by 1990 but not by 2020. The availability of surplus Navy lands will ease the pressure for developable lands, but should not in the long run eliminate the need for carefully guided growth in this area.

Sewer service being proposed for the planning area could serve an additional 200,000 people more than it did in 1970. But 168,000 people already needed service in 1970. Therefore, only 32,000 of the new capacity represents new growth that can be accommodated by sewer service already planned. Severe septic tank limitations on some developable lands will mean those areas will have to be sewered or developed at very low densities.

In addition to land use decisions resulting from the need to accommodate population growth, the planning area faces several decisions about siting large scale facilities and other developments vital to the economic growth and service needs of the planning area. These developments have significant impact on land and water resources by conflicting with Critical Environmental Areas or competing with other uses for limited developable land. The demand for power is steadily growing, but no sites exist that are free from environmental and safety siting problems. Sand and gravel production is active in this planning area. But frequently the best sand and gravel sites are aquifer recharge areas, and care must be exercised to prevent pollution or depletion of the ground water. These issues are discussed further in *Locating Key Facilities*,

*Chapter 9*. Similar considerations apply to solid waste disposal, large scale development, and transportation proposals such as new highways or widening of existing ones.

There is an opportunity — in fact, a need — in the Narragansett Bay planning area to accommodate growth without significantly changing the water and land resources which are major contributors to the planning area's environmental quality. Decision-makers at all levels — federal, state, local, and private — can participate in meeting this aim by applying the approaches set forth below.

## The Solutions

To take advantage of the opportunity to accommodate growth without significantly changing the area's overall environmental quality, the following program is recommended: (a) Protect Critical Environmental Category A resources; (b) Restrict development on Critical Environmental Category B resources; (c) Manage development on developable Categories C, F, and G resources, while guiding growth to areas with existing infrastructure.

A number of existing methods are available for protecting fragile resources such as existing legislation, zoning, building codes, subdivision regulations, and outright purchase. Within the context of existing channels, for Priority Protection Areas:

1. **Protect priority Critical Environmental Areas.** Municipalities should prohibit development on Critical Environmental Areas (Category A, Priority Protection Areas). The appropriate use of these resources includes: water supply, fisheries production, limited recreation, or as scenic and open space lands.

Planning and zoning boards should protect **water bodies** from pollution by restricting adjacent development and by controlling urban runoff through sub-division regulations which require stormwater detention ponds, where feasible. Recommendations in *Chapter 5 of this report* will also help to achieve the state's water quality standards. **Estuaries and shellfish flats** should be protected by prohibiting outfalls of effluent, and prohibiting dredging or near-shore sand and gravel mining. **Wetlands** should be protected through more rigorous enforcement of existing legislation at a local level. (*Chapter 8 of the Regional Report details how the legislation can be improved; Chapter 6 of the Regional Report discusses kinds of assistance available to municipalities.*) Municipalities, using such programs as the Green Acres Program, and private interests should acquire the most valuable wildlife wetlands and surrounding uplands which are mentioned in *Chapter 6 of this report*. **Critical erosion areas and beaches** should be protected by zoning ordinances prohibiting development. *Chapter 6 of the report* includes recommendations for recreational beach development.



The tools for managing Other Protection Areas (Category B) are often similar to those applicable to A resources.

**2. Restrict development on other Critical Environmental Areas. Municipalities should restrict development on Category B Critical Environmental Areas (Other Protection Areas). Suitable uses to be considered for this category should include: agriculture, extensive recreation, forestry, or, in some cases and with proper management, very low density residential use.**

Land and water resources in Category B are shown on Table 2.2. Measures for protecting **flood plains**, described more fully in *Chapter 8 of the Regional Report*, include local flood plain zoning prohibiting further flood plain development, discouraging or prohibiting reconstruction after substantial storm damages, relocation if flood proofing or substantial protection is not available or practical. **Prime agricultural lands** should be protected at the state level by tax incentives, agricultural districts, and acquisition of development rights for the highest priority lands, and at the local level by methods such as transfer of development rights. *(See the Regional Report, Chapter 3, for further discussion.)* **Proposed reservoir sites and unique natural and cultural sites** should be protected by acquisition in fee simple or by easements, or development rights. **Upland erosion areas** should be protected by local sediment and erosion control ordinances *(see Chapter 8)*.

The nearly 73,000 acres of developable lands (Category C, F, and G resources) require some management to retain the intrinsic natural functions which these resources perform. The SENE Study recommends:

**3. Manage growth on Developable Areas. Municipalities should manage growth on Category C resources and encourage growth on Category F and G resources, especially where infrastructure exists or is planned.**

It is worth noting that this recommendation deals with management of all developable areas, both within existing developed areas, and in areas yet to be developed. There are no developable areas in which management of some kind is not required.

On **ground water recharge areas**, communities should restrict housing densities so that septic systems will not endanger ground water quality. Densities requiring sewers should be allowed only after analysis of the economic and environmental feasibility of recharge maintenance techniques to prevent depletion of the aquifer. For details about development standards, refer to Table 3.4; also see *Chapter 4, Water Supply and Chapter 5, Water Quality, in the Regional Report*. Other ordinances and building codes should control coverage by imper-

meable surfaces, require stormwater detention basins for recharge of runoff from roofs, streets, parking lots, and driveways. Regulations and sound engineering practices should be used to minimize the effects of activities hazardous to ground water quality such as sanitary landfill, highway deicing salt, industrial wastes disposal, agricultural runoff, and sand and gravel mining below the water table. On areas with **high landscape quality, best upland wildlife habitat**, and on **unsewered soils with septic system limitation**, only development of very low density should be allowed. Development that would tend to preempt the resource value of wildlife habitat and landscape quality should be carefully evaluated to ensure that adverse impacts are fully taken into account. **Steep slopes** should be protected from erosion by low density use. Development on **moderate limitation areas** should be regulated to correspond to the availability of sewers.



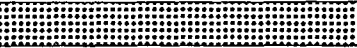
Higher densities than are generally possible on C lands should be encouraged on F and G lands. Such growth should take advantage of existing infrastructure wherever possible. Taking full advantage of existing water supply and wastewater treatment systems as well as existing transportation (especially rail lines) appears to be the most efficient use of public and private funds and still allow protection of valuable shoreline resources. For details about development standards, see Table 3.4.

The SENE Study findings represent a strong beginning for implementing the strategy called for in the three recommendations set out above. The information on the SENE Study Development Capabilities Maps is too generalized to be useful at the site design level of detail. For example, because of scale limitations certain wetlands on the west side of the Kickemuit River in Bristol, R.I. do not appear on Plate 2. Also, the dark green area at the north end of Briggs Marsh in Little Compton does not cover only wetland and well sites as implied in the designation Priority Protection Areas. Municipalities can use the resources information to set priorities for action. As an immediate step, municipalities can concentrate on applying Study findings and recommendations to existing ordinances and building codes using more detailed maps and data. This is particularly important for cities and towns subject to high and medium-high development pressure (see Table 3.1). Further details on protection and management are discussed in *Chapter 3 of the Regional Report*.

Although local governments have much of the authority necessary to implement the concept of guiding growth based on resources capability, its implementation will be most effective if adopted as a matter of state policy. Many of the resources extend beyond town boundaries, and funds and information exist at the state level.

The most expeditious way for the states to implement these concepts would be for their interagency policy councils to review and adopt, as appropriate, the policy issues suggested

TABLE 3.4 SUGGESTED\* GUIDELINES FOR USE OF DEVELOPABLE AREAS SHOWN ON PLATES 1, 2, and 3

MAP COLOR	MAP PATTERN	NONE (color only)			
	Other Resource Limitations Soils Limitations	No other Resource Limitations	High Landscape Quality (Category C <sub>2</sub> )	Upland Wildlife Habitat (Category C <sub>3</sub> )	Aquifer and/or Ground water recharge areas (Category C <sub>1</sub> )
YELLOW	Moderate to No Limitations for septic system disposal (Category F & G)	- PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At least 1/2 ac/DU	If clustered on no more than 50% of area - - PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At least 1/2 ac/DU Unclustered - . Low Intensity I/C . At least 1.0 ac/DU	If clustered on no more than 30% of area - - PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At least 1/2 ac/DU Unclustered - . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 20% of area - - PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At least 1/2 ac/DU Unclustered - . Med. Intensity I/C . At least 1/2 ac/DU Unclustered or no PW & PS - . No I/C . At least 3 ac/DU**
ORANGE	Severe septic system limitations caused by conditions other than slope and ledge soils (Category C <sub>4</sub> )	- PW & PS . Any I/C . Any Res. - PW only . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 50% of area - - PW & PS . Any I/C . Any Res. Unclustered or PW only - . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 30% of area - - PW & PS . Any I/C . Any Res. Unclustered or PW only - . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 20% of area - - PW & PS . Any I/C . Any Res. - PS only . Med. Intensity I/C . At least 1/2 ac/DU - PW only . No I/C . At least 3 ac/DU
BROWN	Ledge and/or steep slope greater than 15% (Category C <sub>5</sub> )	- PW & PS . No I/C . At least 1/2 ac/DU *** - PW only . No I/C . At least 2 ac/DU	. No I/C . At least 3 ac/DU	. No I/C . At least 3 ac/DU	. No I/C . At least 3 ac/DU

\* These are designed to provide a framework for designing guidelines of increasing specificity by state, regional, and local planners, and consultants more intimately knowledgeable with local circumstances.

\*\* In many cases suggested guidelines for development, particularly for ground water, are estimates of probable safe controls made in the absence of greater knowledge of the effects of development on the pollution of aquifers.

\*\*\* Erosion control measures should accompany other restrictions on slopes over 15%.

Med. & Low Intensity - refers to water use/effluent discharge/building coverage

Clustering - refers to percent impermeable land surface area which may adversely effect the resource.

PW - Public Water Supply System

Res. - Residential

PS - Public Sewer System

ac - acre

I/C - Industry/Commercial

DU - Dwelling Unit

herein. Rhode Island has taken a major step in this direction by preparing a comprehensive land use plan. Massachusetts should also continue its program toward developing a comprehensive policy for guiding growth. Such a policy will provide state guidance for development and management decisions in the two Massachusetts towns in this planning area, Rehoboth and Swansea, both of which are subject to medium-high development pressure. The SENE Study recommends:

**4. Use SENE resource development capability analysis to guide future growth.**

The Rhode Island Statewide Planning Program and State Planning Council and the Coastal Resources Management Council should incorporate the SENE resource classification system into the land use policies and plan. In Massachusetts, the Cabinet, with the active participation of regional planning agencies and municipal governments, should develop a land use policy using the SENE resource classification system and recommended policies. Guidelines can be developed at state, regional, and local levels of government. (*See Chapter 10 of the Regional Report.*)

*Chapter 3 in the Regional Report* describes the economic inefficiencies and environmental costs of urban sprawl. Making better use of roads, sewer systems, and water supply systems, where they already exist, could help to avert those costs. Therefore, it is recommended that policies be developed to:

**5. Accommodate growth where services already exist.** The Rhode Island State Planning Council and the Massachusetts Cabinet, in conjunction with towns, regional planning agencies, and state agencies, should establish policies to accommodate further development in already developed areas, and to permit maximum use of existing water, sewer, and transportation services. Planned unit developments and the cluster principle should also be encouraged in these areas.

The Regional Report also recommends establishing a system for determining criteria for locating developments of regional impact. This would be within the framework of the system designed to protect Critical Environmental Areas and manage Developable Areas and would enable consideration of environmental and economic implications in siting decisions. Power plant siting problems in this planning area would be under its jurisdiction. *Details of this recommendation can be found in Chapter 9, Locating Key Facilities, in this and the Regional Report, and Chapter 3 and 10 in the Regional Report on Guiding Growth and Strengthening the Management System for Natural Resources.* Consistent with

siting criteria suggested for other facilities of regional impact, highway planners and state officials should give special consideration to avoiding Critical Environmental Areas (Categories A and B) and using limited Developable Areas (C, F, and G), taking into account other needs for these same lands.

## Priorities

Municipalities which should act especially promptly to carry out the recommended actions are those with high and medium-high development pressure (Table 3.1): Narragansett, North Kingstown, Portsmouth, Warwick, East Greenwich, Rehoboth, and Swansea. Wetlands, prime agricultural lands, and flood plains in these municipalities should be given immediate attention for protection.

## Implications

The impact of these recommendations on development patterns in the planning area, considering the amount and types of land and the projected population, should be significant. Application of SENE Study recommendations throughout the Narragansett Bay Area can make an important difference in trying to ensure that the area continues to be an attractive place to live, work, and spend leisure time.

The projections show that there is not enough developable land to accommodate expected growth in the next 50 years. Over one-third of the entire planning area is available for development even after setting aside critical areas too fragile to accommodate development without unacceptable damages, publicly-owned areas, and already urbanized lands. But that is not enough land, assuming present rates of land consumption. This means one of three things: (1) the land consumption rate is going to have to change, increasing densities on some areas while ensuring protection of others; or (2) some of the growth will have to go to other areas (such as the Pawcatuck planning area); or (3) some of the growth will encroach on some of the Critical Environmental Areas.

The program outlined in this chapter emphasizes the importance of assessing the full range of economic and environmental costs when making development decisions, especially in the Bay area where the impacts of alternative decisions are pronounced. Such an approach is consistent with the policies set forth in Rhode Island's State Land Use Policies and Plan. Most important, this approach shows how the cost of development can be decreased to the taxpayer, and degradation of the remaining fragile natural resources can be prevented at the same time. While the SENE Study is not a comprehensive land use plan, the preceding recommendations represent the key steps that land use planners can take to guide the area's future growth.

## CHAPTER 4 WATER SUPPLY

### The Situation

In 1970, thirteen separate water supply systems provided an average of 25 million gallons of water per day (mgd) to the sixteen cities and towns in the Narragansett Bay planning area. All but four of the systems were small, supplying 1 mgd or less, and most had their own sources of supply. The two largest systems operating in the basin are the Providence system, which in 1970 provided 6.2 mgd, and the Kent County Water Authority, which provided 1.8 mgd to the planning area. The Providence system provides a substantial part of the entire metropolitan Providence area water needs.

Except for aquifers capable of yielding 13 mgd in the Potowomut River valley, 3.6 mgd in the Annaquatucket River Valley, 1.3 mgd in the Pettaquamscutt valley, and aquifers in rural Massachusetts towns at the northern end of the Bay, ground water resources adequate for municipal supply are scarce. Salt water intrusion, thin aquifers, and shallow bedrock all contribute to this condition. Currently, only five communities supply a major portion of their water needs from municipal wells within the planning area. Seven municipalities are now supplied from in-basin surface sources, but the topography and soils of the coastal plain do not lend themselves to construction of large surface water reservoirs. High development pressures, resulting from the attractive recreational environment of the Bay area, are increasing the water supply requirements in all but the most distant sections of the east shore of the Bay and the areas around the recently released naval facilities. The 42 mgd safe yield currently available to the planning area is not

sufficient to meet an estimated 1990 maximum day demand of 53 mgd. Since few developable water supply sources of sufficient quantity or quality to meet future needs are known to exist within the planning area, water will have to be imported from elsewhere in the state to supply a large part of the area's increasing demands.

### The Solutions

#### Regional View in Meeting the Bay's Water Supply Problem

Two of the water supply systems now serving the Narragansett Bay planning area also supply water to other basins within the State of Rhode Island. The Providence Water Supply Board and the Kent County Water Authority serve both the Pawtuxet and the Narragansett Bay planning areas. The Providence Water Supply Board also supplies a large amount of water to the Woonasquatucket-Moshassuck river basin (Blackstone and Vicinity planning area). It is currently anticipated that the Providence system will have to extend new service to as many as four municipalities in the Narragansett Bay planning area by 1990 (Table 4.1).

Aside from ground water resources in the Potowomut, Annaquatucket, and Pettaquamscutt watersheds, alternatives for augmenting the Providence and Kent County systems for Narragansett Bay are limited to surface water sources. Although substantial ground water sources are known to exist in the Pawcatuck planning area, they are not con-

TABLE 4.1 MAXIMUM ANTICIPATED DEMANDS FOR PROVIDENCE WATER SUPPLY SYSTEM (in mgd) -- 1990

Basin	Municipality	Demand
Blackstone	Glocester	0.25
Ten Mile	East Providence	7.75
Woonasquatucket-Moshassuck	North Providence	4.32
	Providence	33.81
	Smithfield	2.10
Pawtuxet	Cranston	15.04
	Johnston	2.96
	Scituate	0.20
Narragansett Bay	Warwick	11.72
	Barrington	1.24
	Bristol - Warren	0.28
		<hr/> 79.67

sidered as a supplement to these major systems since the estimated environmentally acceptable withdrawal is apparently not enough to satisfy the future additional demands of the Bay.

In the Blackstone and Vicinity Planning Area Report, it is recommended that only the Big River Reservoir be built to augment Rhode Island's water supplies by 1990. If the reservoir were managed by the Providence Water Supply Board, this development alone would increase the system's estimated safe yield to 98 mgd. The total estimated demand, using a "current trends" projection (one percent per capita increase in yearly consumption) for water supply in all the communities which are anticipated to be served by the Providence system by 1990, is 80 mgd (See Table 4.2). While the proposed supplies are more than adequate for 1990, it is the SENE Study's conclusion that additional alternatives will become competitive with the current proposals for supplying long-range needs (i.e. 2020). These alternatives are most important in view of the increasing costs of water supply and the impact that further surface water impoundments would have on the limited natural resources of the area. By 1990, the technology for wastewater reclamation and desalination may be developed to the point where they could be seriously considered as alternatives to additional surface water impoundments (as discussed in Chapter 4, *Regional Report*).

### **Existing and Proposed Resources and Opportunities**

Table 4.2 is a list of the existing water resources, estimated 1990 demands, and the proposed sources of future supply for the Narragansett Bay planning area.

**Providence and Kent County Systems.** In 1970, the Providence and Kent County systems sold all water required by the City of Warwick to the Warwick Water Department. This water came from the Providence Water Supply Board's Scituate Reservoir complex, which has an estimated available safe yield of 72.0 mgd.

The Kent County Water Authority, although purchasing some water from the Providence system, has its own sources of supply from wells located in Coventry and East Greenwich, which yield 3.0 mgd and 6.8 mgd respectively. The East Greenwich division of the Authority served all water used by East Greenwich in 1970. Location of wells within the town of East Greenwich makes it likely that the future additional water demands of this town will be supplied totally from these sources. After subtracting East Greenwich's 1990 estimated maximum day demand from the available 9.8 mgd, only 5.9 mgd remains for Warwick, short of a total 1990 anticipated demand of 11.8 mgd. By then, the Scituate Reservoir complex's available yield of

72 mgd will be insufficient to meet even the projected 1990 demands from municipalities now served, and additional sources will have to be developed.

Plans for developing the Big River Reservoir have been recommended by the SENE Study. Specific discussion of this proposal may be found in the *Blackstone and Vicinity Planning Area Report*. The development and management of the reservoir are still open to question. A \$3 million engineering bond issue sought by the Rhode Island Water Resources Board for the reservoir was defeated in a November 1974 referendum. However, the Governor of Rhode Island has stated that consideration of water supply issues will have top priority for his office. Additional consideration of the Big River Reservoir should be forthcoming. The Providence Water Supply Board has not yet been authorized to manage the reservoir.

A pipeline originating in the Big River treatment plant would run northeasterly to a point in West Warwick where it would converge with a pipeline from the Scituate Reservoir complex aqueduct. Accordingly:

- 1. Extend Providence Water Supply Board service to Warwick.** Warwick should seek service directly from the Providence Water Supply Board, if this system manages the Big River Reservoir, and should connect to this source within the next five years (by 1980).

Warwick's need for additional water will not be satisfied by the Kent County Water Authority. If the Big River Reservoir is constructed, Warwick will not only receive sufficient water, but will receive the benefits of regional management and economies of scale by joining the Providence system, if this system indeed manages the Big River Reservoir.

As mentioned above, the East Greenwich division of the Kent County Water Authority supplied all water used by East Greenwich in 1970 from wells in the town. It appears likely that all the 1990 water demands of East Greenwich can be met by its local ground water sources, but care must be taken to preserve these sources and to prevent their degradation. The SENE Study makes the following recommendations:

- 2. Continue ground water exploration in East Greenwich.** The Kent County Water Authority should continue ground water exploration in East Greenwich in conjunction with the U. S. Geological Survey and the Water Resources Board. It should be the policy of the Authority to meet all of East Greenwich's water needs by local ground water only.

The *Regional Report, Chapter 4, Water Supply*, has considered in great detail the economic and social benefits of developing local ground water. Further exploration in conjunction with the U. S. Geological Survey and the Water Resources Board will assure East Greenwich of a sufficient low cost water supply and will permit the town to develop this source with the least environmental harm.

**Narragansett Bay Towns Which Will Be Joining the Providence System.** Another system serving the Bay area is the privately owned Bristol County Water Company.

This system has both ground and surface sources available. Three wells with a combined yield of 0.70 mgd supply the municipality of Barrington. Bristol and Warren, also served by the Bristol County system, are supplied by four surface reservoirs which impound water of the Palmer and Kicke-muit Rivers. The available safe yield from these surface sources, located in Rehoboth and Swansea, Massachusetts, is 2.5 mgd. Although the system has managed to supply the past demands of the three municipalities, average water needs are expected to increase to 6 mgd by 1990. Other sources of supply will have to be used in the near future.

**TABLE 4.2 SUMMARY OF 1990 WATER SUPPLY: NARRAGANSETT BAY**

Municipality	Existing System (1970)		1990 Average Demand mgd	1990 Design Demand mgd <sup>b/</sup>	Proposed Additional Sources of Supply (1990)
	Source	Safe Yield mgd <sup>a/</sup>			
MASSACHUSETTS					
Rehoboth	Private Wells	---	.79	1.75	Wells
Swansea	Wells	2.80	1.62	3.34	Cole River Reservoir
RHODE ISLAND					
Barrington	Wells	0.70	1.94	3.92	Big River Reservoir
Bristol	Reservoirs	2.50 <sup>c/</sup>	2.52	Same	Big River Reservoir
East Greenwich	Wells	6.80 <sup>d/</sup>	1.93	3.91	None
Jamestown	Reservoirs	0.20	.34	Same	None
Little Compton	Private Wells	---	---	---	Private Wells
Middletown	Reservoirs	see Newport	5.39	Same	None
Narragansett	Wells	see N. Kingstown <sup>e/</sup>	1.73	3.55	None
Newport	Reservoirs	9.50 <sup>f/</sup>	4.94	Same	None
New Shoreham (Block Is.)	Wells	0.20	---	---	None
North Kingstown	Wells	10.50 <sup>g/</sup>	4.09	7.63	None
Portsmouth	Reservoirs	see Newport & Tiverton	1.65	Same	None
Tiverton	Reservoir	1.00 <sup>h/</sup>	.67	Same	None
Warren	Reservoirs	see Bristol	1.53	Same	Big River Reservoir
Warwick	Reservoir	i/	11.75	Same	Big River Reservoir

<sup>a/</sup> Ground water yield reported as pumping capacity.

<sup>b/</sup> Systems relying primarily on ground water sources must supply maximum day demands.

<sup>c/</sup> A system of 4 small reservoirs in Rehoboth and Swansea, Massachusetts serving both Bristol and Warren, Rhode Island.

<sup>d/</sup> Wells located in E. Greenwich owned and operated by the Kent County Water Authority.

<sup>e/</sup> Also received an average of 0.72 mgd in 1970 from wells in South Kingstown, an out-of-basin town.

<sup>f/</sup> A series of reservoirs located in Tiverton, Little Compton, Portsmouth, and Middletown, owned and operated by the Newport Department of Water, serving Newport, Middletown, and Portsmouth.

<sup>g/</sup> Total safe yield available from 2 public water systems currently serving N. Kingstown: N. Kingstown Water Department (5.8 mgd) and Quonset Point Naval Station (4.7 mgd). N. Kingstown Water Department also serves part of Narragansett.

<sup>h/</sup> Safe yield developed by the Stone Bridge Fire District and furnished to Tiverton and Portsmouth. Tiverton also purchased an average of 0.27 mgd in 1970 from Fall River, an out-of-basin source.

<sup>i/</sup> Received an average of 7.2 mgd in 1970 from the Providence Water Supply Board's Scituate Reservoir, an out-of-basin source.

There is little chance of increasing ground water development in Rehoboth to serve Bristol County. The rising needs within Rehoboth, and the high peak demands of Barrington in particular, make the ground water alternative for Bristol County less economical than a proposed connection to the Providence system via a pipeline from the junction of the Scituate and Big River Reservoir systems at West Warwick. Again, this recommendation is predicated on the assumption that the Providence Water Supply Board would manage the reservoir. Therefore:

3. **Extend Providence Water Supply Board service to Barrington, Bristol, and Warren.** The Providence Water Supply Board should, within 5 years, implement a 1974 agreement with the Bristol County Water Company to supplement existing supplies serving Barrington, Bristol, and Warren. To facilitate this recommendation, the R.I. Water Resources Board should act immediately to secure funding for the construction of a pipeline under Narragansett Bay to serve these communities.

Once again, the economies of scale realized by a regional water supply system provide a compelling justification for Bristol's entrance into the Providence water system. In this case, it appears that the costs of local ground water will be higher than those of the regional system's supplies.

**Jamestown and Newport Water Systems.** The Jamestown Water System uses two ponds (Carr and Watson Ponds) as its sources of supply for servicing the town of Jamestown. The total safe yield of these ponds is estimated at 0.20 mgd. This amount has proven sufficient for supplying past demands of the town and may, with some augmentation, be almost enough to meet the 0.34 mgd average day demands expected by 1990.

The Jamestown system's safe yield can be increased by more intensive watershed control and management at the existing reservoirs. A 1970 Water Resources Board report indicates these practices are anticipated to bring the yield to 0.45 mgd, which would be more than adequate for meeting projected 1990 demands. Therefore:

4. **Begin an intensive watershed control program for the Jamestown system.** The Jamestown system should immediately begin an intensive watershed control program and its existing reservoir sites, with the purpose of increasing its yields to the point where no more additional sources of supply would be necessary until after 1990.

The control and management of watershed lands will in-

crease the efficiency and productivity of Jamestown's reservoirs.

The City of Newport Department of Water presently supplies all demands from the municipalities of Newport and Middletown, and from most of Portsmouth. This system has large reservoirs in Tiverton and Little Compton and several small ones on Aquidneck Island. The safe yield of these sources is estimated at 9.5 mgd. The Stone Bridge Fire District in Tiverton also provides service to Portsmouth from a reservoir with a total safe yield of only 1.0 mgd. The combined 1990 demand on the Newport system could be as high as 12 mgd.

To meet these demands, an alternative which is currently being investigated by the Rhode Island Water Resources Board (WRB) would provide Portsmouth and Middletown with ground water imported from aquifers in the Pawcatuck planning area. Jamestown and Newport could later be served by the same sources.

As discussed in the *Pawcatuck Planning Area Report*, large and productive aquifers exist in southeastern Rhode Island. Ground water reservoirs in the Usquepaug-Queen and Chipuxet River valleys are estimated to be capable of yielding 17 mgd and 8.6 mgd respectively. However, the U.S. Geological Survey (USGS), in a report on ground water availability in the Pawcatuck River basin, pointed out that export of ground water from the basin will result in depletion of streamflow downstream from future well fields. Because of this, the report cautions that well fields constructed for the purpose of ground water export will have to be carefully designed, and pumping from them will have to be carefully managed, if undesirable depletion of streamflow during periods of dry weather is to be avoided.

A representative of the USGS in Rhode Island has also cautioned that unacceptably high manganese concentrations may develop in some heavily-pumped wells after they are put into production. This potential problem should be anticipated, and provision should be made for eventual installation of manganese removal equipment.

Another problem which must be considered is the cost of the long-distance transmission of ground water. Construction of a pipeline under Narragansett Bay to Portsmouth, Middletown, Jamestown, and Newport was estimated to cost \$19 million in 1974. Furthermore, unless storage facilities are constructed at the receiving end of the pipeline, the cost of meeting maximum day demands with imported ground water will be very high.

Pawcatuck area ground water reserves have been suggested as supplementary supplies to Portsmouth and Middletown because it appears they can be developed more rapidly than surface sources to meet increasing demands in these communi-

ties. However, figures recently provided by the Rhode Island Statewide Planning Program show that, since the closing of the U. S. Navy base on Aquidneck Island in 1973, the populations and water demands of Portsmouth, Middletown, and Newport have decreased significantly. In addition, Rhode Island is attempting to restore the economy of Aquidneck Island to its approximate 1970 level by 1990. Together, these facts indicate that the water needs of lower Narragansett Bay municipalities will not return to pre-1973 levels until sometime after 1990. If so, existing surface sources should be adequate to meet the area's needs through that date. After 1990, other sources (i.e. the Big River Reservoir) may be available to supply modest future increases in demand.

Presently, the Statewide Planning Program's population and economic development projections appear likely. There is a possibility, however, that the naval base land in Newport and Middletown could be opened to a significant level of industrial development. In order to meet possibly high water demands on relatively short notice, it is important that options for Aquidneck Island's water supply be kept open. However, because of the more probable projections of low future water needs on the island, and because of the economic and environmental implications of the WRB proposal, the SENE Study does not recommend exportation of Pawcatuck ground water to the lower Narragansett Bay communities at this time.

Another alternative under consideration to meet the future demands of the Jamestown and Newport water systems is the proposed Big River Reservoir. These supplies would be provided through a pipeline from the proposed Riverpoint junction in West Warwick to the lower Narragansett Bay communities. If the Big River Reservoir is managed by the Providence Water Supply Board it will increase this system's total yield to 98 mgd. SENE Study projections indicate that only 80 mgd of this supply will be needed by Providence system communities by 1990. As explained above, the four lower Narragansett Bay municipalities will probably be self-sufficient through 1990.

After 1990, all four municipalities may need additional supplies. However, with little economic or population growth over 1970 levels anticipated by the Statewide Planning Program, the sum of these communities' needs by 2020 should be very modest. These additional demands should be adequately met by water from the Big River Reservoir.

It appears, then, that if the Statewide Planning Program's predictions are correct, and if economic and population growth reach only 1970 levels by 1990 on Aquidneck Island and in Jamestown, the proposed Big River Reservoir will provide sufficient supplies to supplement the four communities after that date, with additional capacity to meet the future needs of the Providence system communities.

A further word of caution is in order, however. If, after 1990, the four communities require a much greater amount of water from the Big River Reservoir, the additional requirements could, with pressures from other municipalities, result in the need to construct another reservoir. An area in the western sections of Exeter and West Greenwich has been proposed as the site for such a reservoir — the Wood River Reservoir. The importation of Pawcatuck ground water supplies to Middletown, Portsmouth, Newport and Jamestown would, at that later time, be economically unfeasible. Because of the proposed connection between the Big and the Wood River Reservoirs, no additional pipelines would be needed to transport Wood River Reservoir supplies to lower Narragansett Bay communities, while a costly new pipeline would be required if Pawcatuck ground water were imported.

The SENE Study does not recommend construction of the Wood River Reservoir at this time. As discussed in the Pawcatuck Planning Area Report, without management precautions, the reservoir could adversely affect recharge from streams to ground water aquifers during dry years in the Wood River basin. Moreover, the existing and potential recreational uses of the proposed reservoir site, as well as the costs involved in construction of the reservoir, provide strong arguments against its development. If demands on the Big River Reservoir are limited, the need for the Wood River Reservoir could be postponed, perhaps until alternative technologies become economically feasible (*see Chapter 4, Regional Report*).

Considering the above discussion, and with the caveats indicated, the SENE Study makes the following recommendation for Portsmouth, Middletown, Newport, and Jamestown:

- 5. Maintain existing resources, with long-term reliance on the Big River Reservoir, in four lower Narragansett Bay communities.** Portsmouth, Middletown, Newport, and Jamestown should maintain their existing resources, which should prove adequate to meet their projected demands through 1990. However, plans should be made to supplement the island communities' water supplies with water from the Big River Reservoir after 1990.

In addition, to assure the adequacy of Newport's resources, the city should:

- 6. Ensure efficient reallocation of U. S. Navy base water supplies in Newport.** Newport should take steps to assure that water formerly furnished to the U. S. Navy base in that city is efficiently reallocated to areas of the city with increasing water needs.

**Water Supply in More Rural Parts of the Planning Area.** Narragansett is served at present by the Town of



Narragansett Water Department, which actually relies upon two other systems: the Wakefield Water Company, supplied by wells located in South Kingstown with a yield of 3.5 mgd., and the North Kingstown Water Department, also supplied by wells, with a pumping capacity of 5.8 mgd. These sources seem sufficient to satisfy all 1990 demands from this municipality.

By the year 1990, Little Compton and New Shoreham (Block Island) should not be faced with any significant problems concerning water supply. Little Compton is not expected to have sufficient demand to warrant public service by 1990. The privately-owned company now serving New Shoreham appears to have adequate resources to meet future needs of the town through 1990. Although the town does not have additional large-scale surface resources that could be developed, the ground water supplies apparently are adequate to serve its limited future needs. The Rhode Island Department of Health has proposed that New Shoreham purchase the private water company now serving the town.

Rehoboth has no public system and is being supplied by individual private wells. A regional study performed for southeastern Massachusetts states that Rehoboth should have no difficulty in developing existing ground water resources to meet its 1990 maximum day demands. Anticipating future need for a public water system, however, the SENE Study suggests that the town consider the possibility of performing engineering studies and field explorations in order to accurately determine the quantity and quality of ground water in its aquifer. Therefore:

- 7. Rely on ground water in Narragansett, New Shoreham, North Kingstown, and Rehoboth. Narragansett, New Shoreham, North Kingstown, and Rehoboth should continue their reliance on local ground water resources to meet 1990 needs. Further town exploration for well sites and appropriate land use restrictions should be implemented as soon as possible to preserve these resources for the future.**

Once more the reader is referred to a detailed discussion of ground water benefits and costs will be found in *Chapter 4, Water Supply, in the Regional Report*. The desirability of current exploration for future sources of supply is self-evident. It will reduce the social, environmental, and economic costs of future water supply development and prevent the occurrence of future water shortages.

Swansea, now served by the publicly-owned Swansea Water District, will not be able to supply its water needs from the system's wells much beyond 1980, although two recently developed wells are expected to increase the present yield to about 2.8 mgd. Since extensive exploratory drilling pro-

grams in Swansea have revealed no other sources of sufficient quantity to warrant development, Whitman and Howard, Inc., Engineers and Architects, have recommended that two reservoirs utilizing diversion of the Cole River (in Swansea) be constructed to meet the town's future water demands. It has also been suggested that Swansea investigate the possibility of entering into an agreement with the City of Taunton or the City of Fall River, Massachusetts, for the purchase of additional water supplies. The SENE Study makes the following recommendation:

- 8. Construct two offstream reservoirs in Swansea. Swansea should move ahead on construction of two offstream reservoirs to accept diversions from the Cole River.**

The Stone Bridge Fire District sells water to the North Tiverton Fire District which is the system serving Tiverton. In 1970, this transfer averaged 0.08 mgd. North Tiverton Fire District also buys water from an out-of-basin source, the Fall River Water Department, which in 1970 furnished 77 percent of all water used in Tiverton (0.27 mgd). Current water supply projections indicate that an average of only 0.67 mgd will be needed by Tiverton in 1990. This demand might be supplied by sources serving the town at present, but would mean a great reliance on the Fall River system for future supplies.

However, a 1968 study prepared for Tiverton suggests the consolidation of the North Tiverton and Stone Bridge Fire Districts into one municipal system. If such a move is taken by the town, the future demands of Tiverton may be totally supplied by this new system, with no need to depend on the Fall River Water Department. Portsmouth would then lose the service of the Stone Bridge system and will have to rely somewhat more heavily upon the Newport system. The SENE Study recommendation is as follows:

- 9. Consolidate North Tiverton and Stone Bridge Fire Districts. Steps should be taken to consolidate the operations, systems, and resources of the North Tiverton and Stone Bridge Fire Districts to supply Tiverton's future needs from existing local surface water sources.**

This recommendation will enable Tiverton to meet all of its water needs from existing local sources, thus providing an economical water supply for the town. Tiverton's institutional structures would also be simplified by this arrangement because the number of systems supplying water to the town would be reduced.

The North Kingstown Water Department and the Quonset Point Naval Air Station system supply the total water demand of the municipality of North Kingstown. Water is obtained from four gravel-packed wells in the Annaquatucket River valley having a combined pumping capacity of

5.8 mgd. An additional well at Carr Pond is out of service due to an iron-plugged wellscreen and may be abandoned. The U. S. Naval Air Station at Quonset Point served the Air Station and the Naval Construction Battalion located in North Kingstown. This system owns three wells that yield a total 4.7 mgd. In 1970, 1.09 mgd was supplied by the Quonset Point system for domestic use. Both systems might be able to continue serving this municipality until 1990 with their present yields. However, because of the magnitude of withdrawals from the Naval Station wells and Kent County Water Authority's wells, the establishment of programs to monitor potential salt water intrusion in the Hunt River Valley and the establishment of streamflow depletion standards for the Potowomut and Hunt Rivers downstream of the well fields are recommended. Also, because the Quonset Point Naval Air Station and Naval Construction Battalion are closed, an additional amount of water besides that already expended for domestic use will be available. This source could be used by any new industrial development established in the area. However, no estimate of available water is possible at this time.

The SENE Study makes the following recommendation :

10. **Set streamflow depletion standards near North Kingstown's wells.** The Water Resources Board, in conjunction with the U. S. Geological Survey and the North Kingstown Water Department should set streamflow depletion standards in the vicinity of North Kingstown's existing well supplies. In addition, the Water Resources Board, the U. S. Geological Survey, the Kent County Water Authority, and the operators of the Quonset system should carry out programs of monitoring for possible salt water intrusion.

The importance of salt water monitoring to ground water quality is discussed in *Chapter 4 of the Regional Report*. Over-pumping of wells can result in salt water intrusion which could significantly reduce the amount of ground water available for supply. At the same time, over-pumping can cause depletion of streamflow which would be harmful to water quality and stream life, and would limit recreational activities and the availability of water to downstream users.

## CHAPTER 5 WATER QUALITY

### The Situation

Because the waters of Narragansett Bay receive intense commercial and recreational use, the maintenance of its clean waters and improvement of its polluted waters are extremely high priorities, both for the planning area and for Southeastern New England as a whole.

The major water quality problems in Narragansett Bay are caused mainly by combined sewer overflows from the Providence metropolitan area, and to a lesser degree by municipal wastewater discharges, industrial effluents (including cooling water and tank farm stormwater runoff), oil pollution, watercraft wastes, and polluted tributary streams (Taunton, Pawtuxet, and Blackstone Rivers). In addition, some of the smaller coastal streams (Hunt and Saugatucket Rivers) are often adversely affected by malfunctioning septic systems.

Fall River discharges, while technically not in the planning area, present problems to Narragansett Bay. Water quality in Mount Hope Bay is degraded by 14 combined sewer overflows, and also by the primary effluent from the hydraulically overloaded Fall River wastewater treatment facility. Raw wastewater overflows occur even during dry weather from some of the sewers, indicating the severity of the problem. The parameters adversely affected by these problems in Mount Hope Bay include bacteria concentrations, dissolved oxygen, oil and grease, and turbidity.

Brown foam can often be seen at the mouth of the Lees River, and floating debris and refuse is a common sight in this section of Narragansett Bay. Several fish kills have been observed by local residents near the Brayton Point power sta-

tion, and the elevated temperatures in the Lees River, coupled with nutrients entering the Bay from the Taunton River and from the Fall River facility have encouraged substantial growths of marine algae.

Another area with complex water quality problems affecting the Bay is the metropolitan Providence area. While Pawtucket, Providence, and East Providence are not included as planning areas towns (see Blackstone and Vicinity Planning Area Report), each contributes to the water quality degradation in the Seekonk and Providence Rivers and upper Narragansett Bay. As with most older, heavily developed cities, both Pawtucket and Providence have combined sewers. In addition, three wastewater treatment facilities (Blackstone Valley Sewer District, East Providence, and Providence) discharge approximately 20,000 pounds of oxygen-demanding wastes per day into these two tidal rivers. However, the combined sewer systems create the major water quality problem for both the two tidal rivers and the upper Bay. When rainfall in a 24-hour period amounts to one-half inch or more, a portion of upper Narragansett Bay is closed to shellfishing for a period of seven days or more, due to the combined discharge of untreated wastewater and stormwater. Planning area towns having combined sewers include: Newport, Jamestown, and Bristol. Newport has separated part of its combined sewer system.

Over 75,000 people are served by municipal sewer systems in the planning area. This represents just over 25 percent of the total planning area population. Of the people served, more than half live in Newport and Middletown and thus are connected to combined sewers. Where treatment is provided, it is usually only primary treatment (see Table 5.1).

TABLE 5.1 SEWER SERVICE: NARRAGANSETT BAY PLANNING AREA

Sewer System	1971 Population Served	Degree of Treatment	Receiving Waters
Bristol	13,440	Primary	Bristol Cove
East Greenwich	3,815	Secondary	Greenwich Cove
Jamestown	1,410	None	East Passage and Dutch Island Harbor
Middletown	10,300	Served by Newport	
Narragansett	3,360	Primary	Narragansett Bay
Newport	34,562	Primary	Newport Harbor
Warren	7,500	Primary	Warren River
Warwick*	6,600	Secondary	Pawtuxet River

\* see also Pawtuxet Planning Area Report.

## The Solutions

### Preservation

Pressures on the high quality waters of the planning area will increase substantially as growth continues, due to high development pressure. High water quality exists in many portions of the Bay. Anti-degradation policies (*see Chapter 5 of the Regional Report for details*) to preserve existing water quality and construction of facilities to restore water quality to higher standards must be pursued. With this in mind, the SENE Study places high priority on preservation of the Bay's generally high quality waters.

All waters of the planning area, except those in the vicinity of a wastewater discharge, have water quality goals which will allow swimming and fishing. Therefore, virtually the entire planning area could be protected by the anti-degradation statement (as it stands now) which prohibits new wastewater discharges to Class A, B, SA, and SB waters.

Also deserving special emphasis are recommendations dealing with subsurface seepage and disposal of scavenger wastes from septic tanks. Almost 75 percent of the planning area population depends on septic systems for wastewater disposal. This situation may change with the occurrence of new growth and development which, as *Chapter 3 of the Regional Report* suggests, can be channelled towards proposed sewer service areas in order to make the most efficient use of utilities available. However, some of the increased population will still rely on septic systems. Without enforcement of effective criteria and compliance standards, the service areas of municipal treatment facilities will be forced to expand in order to alleviate cumulative septic system failures. Such conditions have resulted in extensions of the Warwick system to protect Buckeye Brook and in similar proposals to protect the Saugatucket River.

### Restoration

Because of the vast amount of recreational boating taking place in the waters of Narragansett Bay each year, the provision of pump-out facilities at the several coastal treatment plant sites will be a first step to eventually phasing out watercraft waste discharges. Further, all marinas in heavily congested harbors and adjacent to major shellfish beds should provide pump-out facilities with either adequate treatment or disposal to a municipal system.

Towns which have been identified as having landfills experiencing problems associated with surface drainage, leachate, and the lowest portion of the fill in the water table include: Middletown, North Kingstown, Portsmouth, and Warren. Landfills in Tiverton and Newport have only the first two characteristics. These are towns for which recommendation 13 in *Chapter 5 of the Regional Report*, calling for landfill/water quality investigations, specifically applies.

**Municipal Facilities.** The following discussion involves a facilities-oriented capital-intensive approach to solving existing water quality problems. Only one municipality without a treatment facility, Rehoboth, does not require construction of a new facility. For other municipalities, the basic differences between alternative municipal facilities configurations is the degree of regionalization involved. Funding construction of these new facilities should receive top priority. Land disposal alternatives were not available because of lack of suitable sites. Stream discharge to the small, coastal streams was considered inappropriate because of their limited assimilative capability and existing high quality. Thus, secondary treatment at coastal facilities was the logical alternative. Alternatives for combined sewers (separation, storage, treatment) were evaluated and the recommendation varies with individual characteristics of the system (*see Chapter 5 of the Regional Report*).

The SENE Study endorses the following facility plans developed by the communities and the Rhode Island Division of Water Supply and Pollution Control:

1. **Construct a secondary wastewater treatment facility in New Shoreham.** New Shoreham (Block Island) will construct a secondary wastewater treatment facility with coastal discharge.

This recommended project has a high priority and could be funded this fiscal year, assuming that a favorable environmental impact statement is prepared by the U. S. Environmental Protection Agency.

2. **Construct a secondary wastewater treatment facility in Narragansett.** South Kingstown will construct a secondary wastewater treatment facility in Narragansett with discharge to Narragansett Bay. Narragansett, South Kingstown, and the University of Rhode Island will be served.

This facility has been funded. Industrial discharges to the Saugatucket River will be eliminated, along with the University of Rhode Island discharge in the Pawcatuck planning area; completion is expected in mid-1976.

3. **Serve Barrington by the East Providence treatment facility.**

This project will be funded this fiscal year and should be completed by mid-1977.

4. **Upgrade the Newport treatment facility to secondary.** Newport will upgrade the existing primary plant to secondary. Newport and Middletown will be served. Portsmouth will construct a secondary plant. After 1995, Ports-

mouth wastewaters will be conveyed to Newport.

The Rhode Island Division of Water Supply and Pollution Control has given higher priority to Newport's combined sewer problem than to the provision of secondary treatment, because it is more important to water quality in Newport Harbor. Therefore, Newport should:

**5. Continue partial separation of combined sewers in conjunction with treatment techniques.**

Micro-straining, a physical treatment method, will be employed at two sites. This treatment technique for combined sewer overflows, and secondary treatment at the municipal facility, will be funded as soon as funds become available, possibly this year; but definitely next. Separation will possibly begin this fiscal year since funds are available and have been requested. The expected completion date is mid-1977.

**6. Continue to serve Warwick by a secondary treatment facility. Warwick will continue to be served by a secondary treatment facility discharging to the Pawtuxet River. Provisions for advanced treatment will be made. (See Pawtuxet Planning Area Report for details.)**

**7. Construct a secondary treatment facility in Jamestown. Jamestown is planning to construct a secondary treatment facility.**

This measure will eliminate five untreated discharges. Every effort should be made by the U. S. Environmental Protection Agency and Rhode Island Division of Water Supply and Pollution Control to fund planning as soon as monies are available. Since the combined system is not extensive, treatment at the plant may be more advantageous than separation. This should be evaluated in the planning phase. The hoped for completion date is in early 1978.

Two recommendations put forth in the Taunton River Basin Plan, produced by the Massachusetts Division of Water Pollution Control for Narragansett Bay planning area towns, are endorsed by the SENE Study. The second is receiving additional study by the Southeastern Regional Planning and Economic Development District.

**8. Serve northern Tiverton by the Fall River treatment facility. Northern Tiverton will be served by the Fall River treatment facility. Such an action would require interstate agreement on the part of the two governors.**

**9. Serve Swansea by the Somerset facility.**

Several variations in current municipal plans are recommended by the SENE Study.

**10. Expand Quonset Point plant to serve North Kingstown and a portion of Warwick. North Kingstown and the Potowomut section of Warwick should be served by an expanded secondary plant at Quonset Point. Discharge would be to the Bay. The presently unserved portion of East Greenwich could either be served at Quonset Point or by expanding their existing treatment facility.**

The planning phase for expansion of the North Kingstown system will be funded this fiscal year (*see Regional Report, Chapter 5*). However, East Greenwich and Potowomut need to be included in that planning. Implementation of such a regional system would result in a reduction in the number of wastewater discharges, economies of scale at the larger plant, and generally improved operating efficiencies.

**11. Upgrade Bristol plant to secondary treatment and serve Warren. Bristol will upgrade its existing primary facility to secondary. Discharge is to Bristol Harbor. Warren should be served by the facility.**

This would eliminate the existing Warren primary treated discharge to the Warren River. Priority is not high since neither discharge is causing noticeable degradation. Preliminary cost estimates show that it would be cheaper if both communities went alone. However, higher water quality would result once the Warren discharge had been eliminated. The sewers in Bristol are affected by excessive infiltration and inflow and must be improved.

In addition, the SENE Study makes the following recommendation:

**12. Abandon Scarborough Hills facility and connect to Narragansett regional facility. The Scarborough Hills (Narragansett) treatment facility should be abandoned and the system connected to the proposed regional facility in Narragansett.**

This last recommendation eliminates a discharge, thereby improving the Scarborough Hills outfall area to Class SB.

Preliminary cost estimates for major interceptors and treatment facilities for these proposals are: Jamestown — \$6,000,000 (additional \$200,000 for combined sewers); New Shoreham — \$700,000; Narragansett — \$1,600,000;

East Greenwich — \$1,000,000; North Kingstown — \$2,500,000; Warwick — \$12,000,000 (includes provisions for advanced treatment); Warren and Bristol — over \$13,000,000; Newport — \$11,000,000 includes Middletown (additional \$5,000,000 for combined sewer abatement); Portsmouth — \$1,600,000. Actual costs to the communities would be approximately 10 percent of the costs presented, assuming eligibility for 90 percent federal and state funding.

In summary, then, water quality throughout the Bay is generally good with only localized exceptions, usually in

the vicinity of an inadequately treated municipal discharge, combined sewer overflow, or, in the case of the Saugatucket, malfunctioning septic systems. Other problems include polluted tributary streams (the Blackstone, Pawtuxet, and Taunton Rivers), and the combined sewer systems of non-planning area towns, principally Providence and Fall River (*discussed in the Blackstone and Taunton Planning Area Reports*).

Recommendations stress preservation techniques where existing water quality is high, and secondary treatment at regional facilities for problem areas.

## CHAPTER 6 OUTDOOR RECREATION

Narragansett Bay, Rhode Island's greatest natural resource and most valuable asset, is a focal point for population growth, recreation, commerce, and fisheries. The Bay covers an area nearly one-fifth as great as the total land area of the state. Most of the major river basins in Rhode Island and some in Massachusetts drain into the Bay, including the Blackstone, Ten Mile, Taunton, Woonasquatucket, Moshassuck, and Pawtuxet Rivers.

The Bay has many islands, the two largest, Aquidneck and Conanicut, are much more heavily developed than Prudence Island which, unlike the others, has no highway access. These three large islands and many smaller ones, and the numerous coves and estuaries, make the Bay a haven for recreational boating, swimming, salt water fishing, camping, picnicking, extensive outdoor recreation, and wildlife and fisheries production. However, existing recreation facilities will not be able to meet the growing recreational demands from this planning area, the other parts of the SENE region — particularly the lower Blackstone area — and outside the region.

Existing beach area will be able to meet about a third of the planning area's 1990 demands; existing picnic facilities could meet about two-thirds of the planning area's future demands; existing campsites could meet about a third of the total 1990 demands for camping; the existing publicly accessible parks and natural areas would meet more than a third of the demands for extensive outdoor recreation; tourism and recreational demands from the nearby Providence metropolitan area inflate this demand further. Recreation resources of Narragansett Bay will increasingly be pressured by the rapidly growing population within this planning area and adjacent ones. The recreational resources in the adjacent Blackstone and Vicinity planning area are adequate to meet only 3 percent of that area's future swimming demands, less than a fifth of its demands for boat ramps and a third of its demands for slips and moorings, and less than half of its demands for extensive outdoor recreation resources. As a result, the pressure on the Bay's resources is that much higher.

Because 75 percent of the planning area is open space (forest, field, open water, wetland), many of these demands could be met with the planning area's resources. There are over 10,000 acres of conservation and recreation lands, most of which (5,900 acres) are privately owned, 2,600 of which are state owned, and 1,500 of which are locally owned. The total represents about 5 percent of the total land area of the planning area and is slightly less than the 8 percent regional average.

### SWIMMING

The Bay shoreline is a combination of small pocket and large regional beaches, including, for example, Scarborough State Beach, Conanicut Island Park State Beach, Sachuest and Newport. Yet, the other shoreline areas, even where no beach exists, do have recreational value. Some areas are excellent for fishing, while many others are scenic and suitable for over-looks, picnic areas, and general parks. Existing parks around the Bay include Goddard, Colt, and Haines; and Fort Adams is under development. In addition, there are several state and Audubon wildlife preserve areas. There are also state piers and fishing access points scattered around the Bay.

About two-thirds of the 18 miles of coastal beaches (including the Islands) are usable. Assuming an average width of 50 feet of beach, the total amount of existing publicly accessible beach is about 40 acres, enough to meet less than a third of the total swimming demands. If properly developed, these 40 acres, plus 35 potentially usable acres of beach could satisfy future demands in the planning area. To meet planning area demands, existing beaches will have to be used more fully and new ones will have to be developed. Therefore, the Study recommends:

1. Continue weekend bus service from Providence to beaches. The Rhode Island Department of Transportation should consider continuing the Department of Natural Resources program of weekend express bus service between Providence and South County Beaches and expand such service between Providence and East Providence, Warwick, and Barrington beaches.
2. Acquire a new public beach in Warwick. The City of Warwick should acquire and develop for general public use a one mile public beach in Warwick, by combining Edgewater Cedar Tree Point, Nausauket, Floating Hospital, and Buttonwoods Beaches with new beach construction as connectors.

The Study also endorses the City's efforts to complete acquisition and development of Conanicut Point, an effort initiated about 10 years ago.

3. Acquire nearly a mile of public beach in North Kingstown. The Town of North Kingstown should acquire Shore Acres and Blue Beach

and Mountview Beach for about a mile of public swimming, and consider the construction of additional beach frontage as connectors at both areas.

**4. Acquire local beaches in Portsmouth, Jamestown, and North Kingstown. Towns should also acquire for local beach development McCurry Point in Portsmouth, Sand Point in Jamestown, and Bissel Cove in North Kingstown.**

However, regional and extra-regional demands for the Bay's beaches must also be accommodated. *Chapter 6 in the Regional Report* recommends efficient use of existing beaches by adding facilities and improving transportation (#1) and/or by nourishing them (#2). In the latter, the following beaches in the Narragansett Bay planning area are proposed for feasibility study: Island Park, Allen Harbor, and Block Island Jetty Beaches. The Department of Natural Resources and the Corps of Engineers should also investigate developing McCurry Point, Ocean Grove, and Sandy Beaches as regional beaches (Regional Recommendation #3).

These combined actions — excluding the feasibility studies of beach nourishment — would make a total of 38.4 additional beach acres available to metropolitan residents, serving a maximum of an additional 33,500 swimmers per day, assuming an average of 50 square feet of beach per person.

Surfcaster, shellfishermen, and swimmers desiring a more remote experience require access to preferably uncrowded conditions. Since by law Rhode Island holds the area between the mean high and mean low watermarks in public trust, the only limitation is access. The Rights of Way Commission has determined that there are access points at three-mile intervals along some parts of the state's coastline. As recommended in *Chapter 6 of The Regional Report*, the following action and its components should be taken:

**5. Secure public access to the shoreline.**

The Rights of Way Commission and Department of Natural Resources should continue their public access program. A minimum of five-mile intervals should be considered. Specific components of this recommendation are:

- The Rhode Island General Assembly should pass legislation exonerating from liability those landowners who permit public access for recreational purposes.
- The Rhode Island Department of Natural Resources should examine on an annual basis markings, conditions, and parking at existing access points along Narragansett Bay. Publications describing the location and extent of ac-

cess points should be widely distributed in post offices, sporting stores, libraries, and the like.

## RECREATIONAL BOATING

The Narragansett Bay planning area is one of the most heavily developed recreational boating areas in the SENE region, accounting for almost 16 percent of the boats based in the SENE area tidal waterways. A significant portion of the recreational boating demand comes from the adjacent counties within Rhode Island, with the remainder coming from the nearby counties in Massachusetts.

The most pressing recreational boating needs in the Narragansett Bay area are the primarily long-term needs for additional marina facilities, moorings, public docks, launching ramps, and adjacent parking areas. Some dredging improvements will be needed, both private and public, in order to provide for this expansion of recreational boating facilities.

On the basis of past navigation studies and an aerial photographic survey, the existing marinas tend to meet an 80 to 90 percent of the existing demand for boat slips. Existing marinas will have to expand, and new marinas will have to be constructed, in order to meet the future demand through 1990. According to the Corps of Engineers, this demand will amount to 3,000 additional boat spaces by 1990, and three times that amount by 2020.

Probably the two greatest indirect deterrents to a continuing high rate of boating expansion are strict controls on the disposal of dredged materials, and the decreasing interest on the part of local communities in publicly supported dredging projects. An important reason for the decreasing interest has been competing and often higher priority demands on tax monies.

With a variety of additional measures, it would be possible to meet the estimated future demands for boat spaces. However, this level of development would significantly alter the character, with damaging consequences for fragile coastal resources, resulting, for example, in the conversion of some residential areas to commercial use.

*Chapter 6 of the Regional Report* describes two options for improving recreational boating facilities and the implications of those options. Specifications for increasing Narragansett Bay's slips and moorings are discussed in this report.

The role of the public sector in this regard concerns improving and maintaining the navigability of the Bay's channels and harbors. Specifically, the following actions are recommended:



6. Construct authorized project at Bristol Harbor. The Corps of Engineers should begin construction of the authorized navigation project at Bristol Harbor as soon as possible.
7. Maintain 14 existing navigation channels. The Rhode Island Department of Natural Resources, in cooperation with the Corps of Engineers, a state boating advisory committee (as proposed in the Regional Report), and towns, should continue to accelerate the maintenance of existing channels to serve commercial and recreational navigation at Great Salt Pond, Block Island and Old Harbors, Wickford Harbor, Wickford Cove, Mill Cove, Sakonnet River, Sakonnet Harbor, Coasters Harbor, Newport Harbor, Apponaug Cove, Warwick Cove, Bullock Cove, and Warren River.
8. Develop 2 new navigation channels and a boat landing. The Rhode Island Department of Natural Resources, in cooperation with the Corps of Engineers and the proposed boating advisory committee, should develop additional navigation channels and basins at Brush Neck Cove, Warwick (city action is pending at the present time to accomplish this with the aid of BOR); assist marina development at Allen Harbor, North Kingstown; construct a public landing ramp and a public small boat landing in southern Pawtuxet Cove.

Private enterprise plays an important role in marina development, but it should be planned and guided. As indicated in recommendation 7 above, the SENE Regional Report recommends formation of a statewide boating advisory committee within the context of the Department of Economic Development's ongoing efforts to promote tourism in Rhode Island. The purpose of the committee would be to plan sound marina development through the most appropriate means, ranging from new developments to more efficient use of existing facilities. Led by the Department of Economic Development, the committee should include state representatives from natural resources and coastal zone planning, but over half the membership should consist of boaters, salt water fishermen, local residents, and conservationists. Specific actions in this planning area include:

9. Guide future development of existing marinas in 22 localities. The proposed state boating advisory committee should encourage private marina operators to expand existing facilities to their maximum feasible potential, given local conditions, or to develop new ones. Special consideration should be given to maintaining high water quality where it exists — Specific locations for the expansion of marina facilities, moorings, and launching ramps include:

Great Salt Pond (New Shoreham), Wickford Harbor, Greenwich Cove, Sakonnet River, Newport Harbor, Brenton Cove, Jamestown

TABLE 6.1 RECONNAISSANCE OF POTENTIAL FOR RECREATIONAL BOATING FACILITIES \*

Municipality	Potential Additional Slips	Potential Additional Moorings	Potential Additional Spaces
Bristol	80	320	400
Somerset	120	---	120
Warwick	120	20	140
East Greenwich	120	30	150
North Kingstown	840	120	960
Portsmouth	---	40	40
Newport	385	50	435
Jamestown	120	50	170
New Shoreham	460	50	510
Totals	2,245	680	2,925

\* These are preliminary estimates and should not be construed as justification for marina development or expansion. Further study — either by towns or by the proposed statewide boating advisory committee (see recommendation 5 in Chapter 6 of the Regional Report) — is needed to determine appropriateness and capacities for new facilities.

Harbor, Dutch Island Harbor, Block Island, Old Harbor, Wickford Cove, Mill Cove, Potowomut River, Cole River, Apponaug Cove, Warwick Cove, Bullock Cove, Warren River, Barrington River, Bristol Harbor, Mt. Hope Bay, and Lee River.

The committee could devise regulations regarding the design of new marinas that would minimize disruption of currents, restriction of the tidal prism, and excavation in shallow water, and prohibit removal of barrier beaches, filling of wetlands, and filling of shallows beyond the normal high water line.

Finally, because of the Bay area's tremendous popularity, new marinas may be advisable, and given breakwater protection, there are several locations which could serve as large regional harbors:

10. Investigate new regional harbors in Narragansett Bay. The Corps of Engineers, in conjunction with the Rhode Island Coastal Resources Management Council and the University of Rhode Island's Sea Grant Program, should investigate the needs, feasibility, and environmental impacts of developing large regional recreational harbors in Greenwich Bay, Allen Harbor, Coddington Cove, the Seekonk River, and Coggeshall Cove.

## GENERAL OUTDOOR RECREATION

Aside from enjoying Narragansett Bay's beaches and boating opportunities, people also visit the Bay area for natural and historical amenities. Picnicking, camping, and extensive outdoor recreation play important roles in the Bay area's recreational scene.

There are a number of ways to increase the amount of camping, picnicking, and passive outdoor recreation opportunities. Picnic tables, campsites, and trailer hook-ups could be added to the existing state parks and privately owned recreation areas. Intensifying the use of existing facilities often lowers the quality of the recreation experience and increases environmental impacts, but makes better use of the existing infrastructure and is less expensive than acquiring and developing new natural areas. Intensifying the use of existing state facilities, given their limited numbers, however, would do little in the way of satisfying future demands in this planning area.

### The Narragansett Bay Islands Park

The remaining natural islands of Narragansett Bay represent a priceless opportunity for preservation. At present, these

islands are, for the most part, undeveloped for recreation or any other use, although some residential development exists. The Bay's historic and natural resources presently contribute significantly to satisfying some outdoor recreation demands, and to enhancing the Providence area's quality of life. The State Outdoor Recreation Plan proposes an Islands National Park including Patience and parts of Prudence Islands, Dutch, Despair, and Gooseberry Islands, and the northern end of Conanicut and possibly Hope Islands at some future time; Fox and Plum Beach Light Islands could be added to this listing. The general consensus among state agencies is that any recreation plan for the islands should aim at preserving inherent qualities for non-intensive recreation. Therefore, most of the area is planned for extensive outdoor recreation but there are provisions for campground, picnic, beach, and boating facilities. The park system calls for increased public access and improved transportation.

In addition, the Department of Natural Resources could use surplus military properties such as Allen Harbor and the Melville coastal strips. Recreation plans for surplus military lands are being reviewed by the Governor's Office for Policy and Program Review. This Office is responsible for the coordination of planning activities for surplus military properties in the state and has prepared a plan toward this end. In addition, several existing public areas, such as Goddard Park in Warwick, Haines Park in East Providence and Barrington, Colt State Park in Bristol, and Fort Adams in Newport, can be incorporated into the eventual Bay Islands program. The ex-military areas, considered with the above-mentioned Islands, would provide over 5,500 acres for combined recreational activities including swimming, surfcasting, boating, and salt water fishing, hiking and picnicking.

The following actions are therefore recommended:

11. Develop Narragansett Bay Islands Park. The State of Rhode Island should give the highest priority to the development of a Narragansett Bay Islands Park and, with the cooperation of the U. S. Bureau of Outdoor Recreation, should expedite the funding, purchase, and construction of facilities needed to establish such a state park. The proposal involves the acquisition of a few new islands, and development of recreational facilities on Prudence Island in Jamestown, and on the mainland at Quonset Point, Melville (in accordance with other reuse plans), and at Goddard Park. The total investment would amount to \$6 million, for acquisition and development. Other components of this recommendation are:

- Outdoor recreation by all income groups should be encouraged:

- by providing public water-bourne access to the Bay Islands from Upper Bay metropolitan areas,
  - by providing as many non-overnight recreation opportunities on the islands most convenient to the Upper Bay as possible, and
  - by providing a water-based transportation system for moving to, and between, the Islands that is sufficiently inexpensive as to not represent a financial deterrent.
- **Specialized services and facilities should be provided where a clear demand for them does not conflict with environmental considerations.** Examples of such services might be slips, moorings, and gas pumps, or various types of equipment rentals. However, a general user fee, if imposed, should not be so high as to serve as a deterrent to the low income public.
  - **Overnight recreational opportunities should emphasize short duration family and group camping and secure mooring areas for Bay boaters.**
  - **Overnight facilities will be most heavily used by income levels able and willing to invest in the experience.** A moderate fee in addition to any general user fee might, therefore, be charged to offset the cost of developing and maintaining such facilities.

## **Block Island**

Located about twelve miles off the southern shore of Rhode Island is the island township of New Shoreham, popularly known as Block Island. The Island is roughly triangular in shape, measuring about three and a half miles wide by about seven miles long. It forms a link in the glacial moraine deposits off the northeastern shore that stretches from Long Island to Cape Cod.

Block Island is relatively undeveloped and provides many recreational opportunities with its large harbor, steep cliffs, beaches, and inland lakes. Important water related resources are the fragile beach areas on the western shore, north of the Great Salt Pond, the south-central highlands where ground water recharge occurs, the privately owned and seriously eroding bluffs on the south shore, and large fresh water ponds throughout the Island.

Block Island's heyday of tourism occurred in the late 1880's when it attracted many people from great distances. It became a fashionable resort boasting several fine hotels and large summer homes. Now the Island is rapidly rising out of the decline which followed its period of popularity. The Island's present protective anonymity, caused by its relative isolation and low key transportation connections from the mainland, has preserved its natural beauty and charm thus far. But since Block Island lies well within the urbanizing belt of the northeastern United States, it will soon be subjected to the same recreational and developmental pressures that have affected other islands nearby.

It is clear, then, that the Island's unspoiled natural beauty is a threatened asset. If the Island is to remain a non-commercialized haven for tourists, all forms of development must be carefully planned. The salt water marshes, the beach and dune areas, and areas subject to flooding should be protected. Fortunately, this is recognized in the recent town plan, which the SENE Study strongly endorses. The Study also endorses the recommendations for zoning revisions made in the Block Island Study done by the Department of Landscape Architecture at the Rhode Island School of Design.

Accordingly, the following actions are recommended in order of priority, although they have lower priority, in terms of meeting regional recreation demands, than others discussed in this report.

## **12. Develop Block Island for recreation. Develop Block Island for recreation, including the following:**

- **The Rhode Island Statewide Planning Program and the Rhode Island Department of Community Affairs should immediately provide strong technical assistance to the Town of New Shoreham to initiate an aggressive program of implementing the town land use plan recommendations, and to consider the innovative rezoning proposals in the report by the School of Design.**
- **The town should take firm steps to discourage the use of non-resident automobiles on the Island and establish a limit for residential auto use. A fee system for cars, or perhaps even a complete ban on their seasonal use, should be considered. An extremely successful example of such a ban is that used on Mackinack Island in Michigan.**
- **Private investors should be encouraged to provide suitable bus, taxi, or bicycle rental services to increase the available**

facilities capacity to meet growing demands.

- Some of the larger fresh water ponds should be protected and limited access provided for wildlife study, hiking, or photography.

Block Island (New Shoreham) should preserve its special character and, consequently, maintain high quality tourist attractions. Banning tourist cars or charging fees, and developing a public transportation system, would help to alleviate some of the traffic congestion. Through protective zoning and/or acquisition, the town could preserve the bluffs, beaches, inland lakes, and salt marshes and, assuming that public access is guaranteed, 312 acres of natural area would be available for walking, nature study, and picnicking. The total cost would be on the order of magnitude of several million dollars.

### Additional Alternative Solutions

Another alternative is acquiring and developing new recreation resources within the planning area. There are 34,000 acres of Category A Critical Environmental Areas and 34,000 acres of Category B Critical Environmental Areas (*see Chapter 3 of this report for specific kinds of resources in each category*), some of which the state could acquire for new natural areas and parks. Towns and private interests could protect about 270 unique cultural sites and over 14,600 acres of unique natural sites identified in the SENE Environmental Base Study, through direct purchase, easements, historic zoning, and some local zoning. The proposed Narragansett Bay Islands Park, described previously in this section, comprises the largest single unique cultural and natural resource in the state. Because the Bay Islands are central to the character of Rhode Island and such a large portion of the state's unmet recreation needs, regional recommendation number 16 has received highest priority of the recreation recommendations.

In certain portions of the SENE region, water supply watershed lands could provide substantial recreational opportunities for non-water contact recreation, the intensity and location of which would depend on the carrying capacities of the resources, and whether or not the reservoir in question is a storage reservoir or a distribution reservoir (*see discussion in Regional Report, Chapter 6*).

These alternative solutions can be combined in any number of ways, depending on the objective. If one were to develop recreation resources in the Narragansett Bay planning area purely for economic objectives, solutions involving intensive development of facilities would be recommended. To develop a tourist business, a large number of campsites and picnic facilities and related services (sewers, roads, com-

mmercial support) have to be constructed. This approach would not preserve resources, and could make protection and management of open spaces difficult.

Another plan could aim at protecting the amenities and quality of life so characteristic of Narragansett Bay. Actions to meet this objective would include large public expenditures to acquire natural resources for conservation and limited recreation use. While succeeding in preserving resources, the plan may contribute only minimally to the health of the economy.

### Additional Recommendations

Nearly a dozen alternative solutions have been evaluated in terms of economic and environmental costs and benefits, contribution to social well-being, the amount of future recreational needs, and impact on regional infrastructure.

Consistent with recommended recreational policies for the SENE region, high priority was given to actions which greatly improved recreational opportunities near the largest source of unsatisfied recreational demands. The Providence metropolitan area is intensively developed, and residents could greatly profit from linkages with nearby natural areas. A continuous recreation and conservation corridor could be developed from Hundred Acre Cove in Barrington to the Ten Mile River Reservation in Pawtucket. It would follow the Runnin's River north to its headwaters, and then to the Ten Mile, where it would continue along Turner Reservoir and beyond (*for the Ten Mile Basin section, see the Blackstone and Vicinity Planning Area Report*). This park is recommended in the town plans and presents an unusual opportunity for a large recreation corridor. Although it would cost several million dollars, development of this park would supply nearly 700 acres for picnicking and passive outdoor recreation enjoyment. Therefore,

13. **Develop area around Hundred Acre Cove and Runnin's River.** The area around Hundred Acre Cove and the Runnin's River should be developed jointly by Barrington, Warren, and East Providence, Rhode Island in conjunction with Seekonk, Massachusetts, primarily as conservation areas with limited picnicking, hiking, and limited boating. Facilities for more intensive recreation should be developed upstream along the Ten Mile River in Massachusetts.

Several unusual natural areas in the northern bay towns still exist amid the concentration of urban development. Although they would not supply as many recreational demands as the "high priority" solutions, they would supply nearly 50 acres of urban park at a cost of a little over a million dollars. Therefore, the Study recommends:

- 14. Develop urban parks along Warwick's coast.** Communities and/or the Rhode Island Department of Natural Resources should acquire coastal open spaces in the northern towns of Narragansett Bay. For example: Warwick could develop an urban park along Spring Green Pond and Brook, Occupesetuxet Cove, and Oakland Beach.

Although not as widely known as the Bay's coastal resources, there are a few unique riverine corridors within the planning area which are important assets for the overall quality of life. The Kickemuit River, the only river of highest quality water feeding into Mt. Hope Bay, could continue to provide significant non-commercial outdoor recreation opportunities if protected. In addition, there are several areas along the Pettaquamscutt River which remain largely undeveloped. At least one of these could be developed as a park including some picnicking, perhaps camping, and some limited swimming. Although these are significant resources in terms of protecting the quality of life in the planning area, they are given minimum priority in terms of meeting recreational demands in the planning area as a whole.

- 15. Protect Pettaquamscutt River Corridor for low-intensity recreation and conservation.** The Narrow River Preservation Association has undertaken an ecological study in order to develop a comprehensive land use plan. That study should help produce a land use plan (assuming the preservation of the Pettaquamscutt River Corridor through zoning, easements, and purchase of key parcels of land) to identify suitable sites for recreational development (picnic areas, and camping, wherever feasible).

There are several ponds in North Kingstown representing other water related resources which offer the potential for meeting fewer picnicking and extensive outdoor recreation needs than other recommendations. At the cost of a few million dollars, access for picnicking facilities and scenic natural views could be gained to nearly a hundred acres. Therefore, lower priority should be given to the following recommendation:

- 16. Acquire access to Secret Lake and Kettle Hole Pond.** The Rhode Island Department of Natural Resources should acquire public access to Secret Lake and Kettle Hole Pond in North Kingstown.

Plate 3 shows the location of Critical Environmental Areas which, as explained in *Chapter 3*, have important roles in natural processes such as riverine and coastal flooding and erosion protection, water supply, and wildlife protection.

These areas require protection, but they can also be used for varying degrees of recreation. Since protection and development of such resources is best coordinated at the local level, the SENE Study recommends that municipalities:

- 17. Use SENE Development Capabilities Maps for open space protection.** Municipalities should plan Critical Environmental Areas identified on the Study's Development Capabilities Map (Plate 3) for open space. Protecting such resources without outright acquisition is described in *Chapter 3 of the Regional Report*.

## **WILDLIFE AND FRESH WATER FISHERIES**

Most of the Narragansett Bay planning area is in open space: some 75 percent of the area is either forest, agricultural, open wetlands, or open water. About half the forested area is good wildlife habitat, but only 3.6 percent of the planning area's wildlife habitat is open to hunting. About 860 acres are publicly owned and open to public hunting, another 7,000 acres are privately owned and open to hunting. The Narragansett Bay planning area's wetland resources provide some of the best habitat for waterfowl production, migration, and wintering grounds in the SENE Study area. Although recreational use of wetlands is low, the U. S. Fish and Wildlife Service estimates that demands for hunting in wetland habitats will increase substantially by 1990, and the wetlands presently publicly available for hunting would scarcely meet a trace of those demands.

If the 7800 acres of land open to hunter use remain open, they will support less than 2 percent of the projected 1990 demands. Aside from inadequate amounts of publicly accessible hunting lands, some towns prohibit the discharge of firearms, and poaching threatens the come-back of Rhode Island's deer population. While hunting would appear somewhat out of the picture in the planning area, protection of wildlife habitat is important for non-hunting enjoyment, by far the largest demand.

Of the 52 (2,868 acres) fresh water ponds, 10 acres and larger within this basin, only 5 (360 acres) have guaranteed statewide public access. The 36 miles of stream are largely in private ownership and can be closed to public fishing. If all these waters had adequate public access and were under fisheries management, they could support an estimated 160,000 man days of fishing, approximately 25 percent of the planning area's 1990 demand.

**Alternative Measures.** Several measures for improving hunting opportunities were considered in this planning area.

Acquisition of parts of a large wetland in Little Compton (other parts are already protected by conservation easements) and the estuaries along the Narrow River is recommended in *Chapter 6 of the Regional Report* as a means for protecting highly productive wildlife areas of regional significance. An option of acquiring public access to all 143,000 acres of wildlife habitat was not recommended, first, because of the expense involved, second, because hunting is prohibited in several towns, and, third, because public preferences expressed at the Narragansett Bay public workshop did not support the idea of public access to privately-owned land.

Increasing wildlife productivity through management of the planning area's abundant forest resources was also considered. Information was not available to ascertain the effectiveness of options such as arranging state management of privately owned wildlife lands in exchange for public access, or the possibility of enlarging the boundaries of state hunting areas. Private organizations also will play increasingly important roles in protecting valuable wildlife habitat to meet needs for nature study and open space. Past experience indicates that most wildlife enjoyment occurs on privately or quasi-privately owned land.

Strengthening wetlands protection under existing legislation, and acquiring wetlands for hunting and/or wildlife protection, were estimated to be the best of the possible actions. Creating new wetlands was not recommended for the near future because the high costs involved in initial outlay would be better spent in acquiring wetlands which already exist and are known to be highly productive. But in the long-run, the Study does recommend further investigation of the possibility of creating new wetlands.

Gaining public access to water supply reservoirs was another alternative considered. As mentioned in *Chapter 6 in the Regional Report*, water supply watershed lands represent a significant recreational resource, although for legal and health reasons local authorities discourage this use for such lands. Improved water treatment technologies and estimating environmental carrying capacities, at least for *storage* reservoirs, could help to put the minds of local decision-makers at ease.

An alternative of creating impoundments was not recommended because of the high costs and low return on satisfying total 1990 demands. While public sentiment against expanding licensing programs is very strong, the fact that many fishermen are unlicensed must be kept in mind, and some compensation for their pleasure should be instituted. Revenues gained from an expanded program are important for improving the planning area's low productivity. Acquiring linear streambank rights-of-way within a minimum width of 20 feet per bank was also considered.

**Recommendations** Because outright acquisition most assuredly provides a high quality recreational experience and would satisfy the largest portion of 1990 demands, the Study places high priority on the recommendations which follow.

For wildlife production:

- 18. Provide assistance to municipalities for enforcing wetlands legislation. The Rhode Island Department of Natural Resources should provide additional legal and technical assistance to local communities to strengthen enforcement of wetlands legislation.**

Edges between forest field and wetland are the most productive wildlife habitats. Some of the Study's major policies involve the protection of prime agricultural soils, wetlands, and unique natural areas (components of Category A and B lands). Actions to protect these resources (*described in Chapter 3 of the Regional Report*) have secondary benefits for the wildlife enthusiast or hunter because of the implications for wildlife productivity.

For fishing:

- 19. Acquire public access to ponds with high potential for fisheries production. The Rhode Island Department of Natural Resources should acquire access to ponds with high potential for fisheries production. There are at least 20 ponds for the planning area with this potential. This list, too lengthy for this report, can be obtained from a SENE Study Single-Purpose Inventory in the NERBC files.**

Lower priority recommendations are those which assure the satisfaction of a smaller portion of fish and wildlife related demands:

- 20. Acquire significant wildlife wetlands. Municipalities, and/or private organizations, should consider acquiring significant upland and wetland wildlife habitat which is currently not protected by scenic, conservation, or agricultural easements (identified on SENE Study single-purpose inventory materials available at NERBC).**
- 21. Acquire public access to 5 streams. Rhode Island and Massachusetts Fish and Wildlife agencies should acquire access to streams with high potential for fishery production. The SENE Study single-purpose inventory has identified 5 as**

most important: In Massachusetts: Palmer River, Swansea (recommended in *Chapter 6 of the Regional Report* for acquisition because of regional value); Rocky Run, Rehoboth; Cole River, Swansea. In Rhode Island: Hunt River, East Greenwich and North Kingstown; Saugatucket River, in South Kingstown.

## ANADROMOUS FISH RESTORATION

Although there are no flood protection dams in the Narragansett Bay planning area, industrial dams have been built on some streams. These dams, coupled with poor water quality and inadequate streamflow, have drastically reduced anadromous fish resources from the Narragansett Bay coastal streams. The Rhode Island Department of Natural Resources has an active program of access purchase, fishway construction, stream improvement, and stocking. It is also constructing fish ladders and fishways on the Hunt River in North Kingstown and East River, the Cole River in Swansea, the Saugatucket River in South Kingstown, and the Annaquatucket River in North Kingstown. If pollution is decreased, this program will do much to improve the stocks of anadromous fish.

### 22. Improve anadromous fish stocks. A plan to improve anadromous fish stocks would include these components:

- Rhode Island and Massachusetts fish and wildlife agencies should maintain fish ladders where they already exist.
- The Rhode Island Division of Water Supply and Pollution Control and the Massachusetts Division of Water Pollution Control should take all necessary measures to reduce pollution levels on all of the above and the following rivers to 1977 standards: Gorton Pond and Buckeye Brook in Warwick; Echo Lake and Backyard Pond in Barrington; Runnin's River in Seekonk; Rocky River in Rehoboth; Lees River in Swansea; Nonquit Pond in Tiverton; Easton Pond in Newport; and other small coastal streams.
- The local communities and/or the state agencies responsible for fish

and wildlife production should purchase streambanks to provide access to those streams with anadromous fish runs.

## IMPLICATIONS

Taken together, these actions comprise a recreation program for the Narragansett Bay planning area which aims to satisfy local and tourist demands for this regionally significant playground and to protect the resources which epitomize Rhode Island's heritage. Where possible, high priority is given to expanding existing facilities, but sizable acquisitions are recommended near urban centers, both to satisfy demands and to protect resources which enhance the quality of life in these areas.

Actions in the beach program, which could cost several million dollars, could satisfy a large portion of the 1990 in-basin demands for swimming. Boating actions are designed to meet most of the in-basin 1990 demands, and costs to private developers (and ultimately the consumer) would exceed a million dollars. Actions to improve camping, picnicking, and extensive outdoor recreation would meet nearly all the in-basin 1990 demands for picnicking, nearly three-quarters of the in-basin 1990 camping demands and almost half the 1990 demands for extensive outdoor recreation at a cost of over \$10 million. Actions to satisfy 1990 demands for hunting would meet over 50 percent of the 1990 planning areas' demands (assuming that nearly all A and B lands are open to hunting), about 10 percent of the future fresh water fishing demands, and greatly improve the quality and protection of wildlife habitats.

Unsatisfied demands of campers, picnickers, and boaters will have to be met largely by private developments of these facilities, which can occur as long as municipalities permit them. Coastal cities and towns in the planning area will more and more have to accept pressures on their beaches and consider opening them for public access. However, most of the actions rely heavily on a combination of state and local action. The larger state actions are more likely to meet regional needs and require investments beyond the scope of most communities. Local actions, urban parks, local beaches, and acquisition of town conversation lands help to meet near-home recreational needs, and are especially important, taken as a whole.

Priorities in this recreational program reflect preferences gathered from Narragansett Bay area residents who, at recent Study workshops, expressed strong preferences for implementing the Narragansett Bay Islands Park proposal.

## CHAPTER 7 MARINE MANAGEMENT

The major marine-related issues in the Narragansett Bay planning area concern port development, and shellfishing, and urban waterfront use. Although discussion in this report will deal only with these topics, additional information from a wider perspective can be found in *the Regional Report, Chapter 7, Marine Management*. That chapter in the Regional Report covers offshore fisheries, shellfish and aquaculture, port development, offshore sand and gravel, and urban waterfronts.

Additional marine-related topics, such as recreational boating, beach swimming, coastal access, and salt water sport-fishing can be found in *Chapter 6 of this Planning Area Report or in the Regional Report*. Similarly, discussions on power plant siting, including coastal sites, and regional petroleum needs, including coastal implications for tank farms, are to be found in *Chapter 9, Locating Key Facilities of the Regional Report*.

This chapter also includes discussion of the navigation needs of the lower Taunton estuary in the Tiverton-Fall River ship channel, as well as for Providence Harbor channel and wharfage. Since Providence, in the SENE Study, is technically classified as a Blackstone planning area municipality, it is significant to note that it has been included with this overall discussion of Narragansett Bay.

### COMMERCIAL NAVIGATION IN THE BAY

The East Passage and the waters at the head of Narragansett Bay provide deep-draft access through a 40-foot channel to Providence Harbor and to Fall River Harbor via a 35-foot channel. Providence Harbor, which ranks fourth in tonnage in New England, handled 9.2 million tons in 1972; and Fall River Harbor, which ranks sixth in New England, handled 4.3 million tons in 1972. In 1972, these two ports handled roughly 31 percent of the petroleum products received at SENE area ports. By 1990, it is anticipated that a majority of the tankers and dry cargo vessels visiting these harbors will have drafts in the 35-foot to 39-foot range.

Twenty-three piers, wharves, and docks make up the terminal facilities for the port of Providence. Commodities handled vary from general cargo to petroleum products, caustic soda, cement, sulphuric acid, and construction materials. Thirteen waterfront facilities are equipped to receive and/or ship petroleum products, which presently account for 90 percent of the total tonnage moving through the port. Most facilities are privately owned, the two chief exceptions being the Municipal Wharf and State Pier Number 1. Municipal Wharf

is owned and operated by the City of Providence. It has 3,350 feet of berthing space, two transit sheds with 136,640 square feet of storage, about 40 acres of paved open storage area, and is considered a general cargo facility. The Rhode Island Department of Natural Resources Division of Coastal Resources operates Pier No. 1, with 1,300 feet of berthing space, limited inside storage, 20 acres of open storage, and handling space for general cargo and bulk cement. It is also the berthing area for official craft such as police and fire boats.

There are no port provisions for major vessel repairs or the dry-docking of deep-draft vessels. Boiler repair, electrical equipment repair, welding and machine, and general maintenance firms in the port are capable of limited repairs in their shops or aboard ship.

A fleet of four tugboats operates in Providence and provides docking services for the port of Fall River, Massachusetts as well.

The annual number of vessel arrivals and departures over the last 15 years has remained about constant. Dry cargo vessel movement has decreased somewhat, present traffic consisting of bulk carriers, tramp general cargo ships, and occasional liner service freighters. Though petroleum product movement has greatly increased, tanker movements are down by 75 percent, indicating a trend to barge movements and larger tankers. Providence serves a function as a coastwise redistribution point for various petroleum products to smaller ports in the area.

The port has a keen interest in the area of dry cargo. The city presently has plans to expand its municipal wharf by the addition of two berths and one warehouse. They believe that dry cargo volume can be increased by 25 percent with proper facility improvements. In addition, the Maritime Administration anticipates that increasing numbers of large oil and liquid cargo barges will visit Providence Harbor.

An attempt to open the largest Liquefied Natural Gas (LNG) receiving facility on the East Coast has been made in Providence. Built by Algonquin Gas Company on Providence Gas Company land, the three proposed storage tanks have a total capacity of 1,800,000 barrels. One tank was completed in the spring of 1974, and was ready to commence in the handling of large, new, presently contracted-for tankers in 1975. These vessels run almost 1,000 feet in length, 135-145 feet in width, have a 36-foot operating draft, and will discharge 1.5 million cubic feet of LNG every 28 days. The danger of pollution from LNG is reported to be less than heavier fuel oils. These ships, therefore, would pose less en-



vironmental threat to the Bay's recreational value than would supertanker cargos of crude oil.

The third largest commercial port in the Narragansett Bay planning area is that of Newport Harbor which handled 90,996 tons in 1972. Petroleum products account for almost 94 percent of the total tonnage landed at Newport Harbor, with the remainder consisting mainly of fresh fish and shellfish.

The commercial fishing harbor at Galilee, on Point Judith, has become one of the most active SENE fishing ports, ranking with Gloucester and New Bedford in activity. Primary needs center on the deepening of the main channel to service the larger fishing fleet.

Commercial navigation needs will be met following completion of the 40-foot deep channel for Fall River Harbor. All of the basic dredging work on the Providence River channel was completed in 1972, with the exception of three areas of rock pinnacles southeast of Conimicut Point. The work remaining (scheduled for completion in mid-1976) entails the removal of an estimated 100,000 cubic yards of rock ledge within the authorized channel limits which is presently endangering shipping.

Dredging of the two 40-foot deep channels at Fall River Harbor and Tiverton has been held up by the matter of disposing of 4.5 million cubic yards of dredged materials. Environmental field surveys are being made concerning use of proposed dredged materials disposal sites.

Because of the area's continued vulnerability to extreme tidal flooding, engineering of all new port facilities requires special care. In *Chapter 8*, this report calls for flood proofing waterfront facilities.

In light of the above, the following recommendations are made:

1. **Complete Fall River channel as soon as suitable disposal sites are approved.** The states of Rhode Island and Massachusetts should consider the findings of the study of preliminary land disposal site identification for dredged materials being undertaken by the Corps of Engineers for the SENE region in order to allow the deepening of the existing 400-foot wide by 35-foot deep Mount Hope channel to 40 feet; to deepen the existing 400-foot wide by 35-foot deep Tiverton waterfront; and to alter the Brightman Street Bridge to provide for a clear channel width, all of the above serving the Greater Fall River waterfront.

## 2. **Complete Providence channel.**

Based on currently approved disposal sites, the deepening of a 40-foot Providence River and Harbor Project channel improvement, which extends southward into Narragansett Bay from Warwick to Portsmouth should be completed in 1976.

## 3. **Develop channel improvements for Newport and Point Judith fishing industry.** Develop channel improvements in Newport Harbor and Point Judith for commercial fishing.

## 4. **Develop rigid operational guidelines for LNG and oil development.** The state of Rhode Island should maximize efforts to develop environmentally acceptable, yet economically feasible, guidelines for the operation of its liquified natural gas (LNG) complex and associated navigation facilities so as to ensure the continued high value of Narragansett Bay as the region's preeminent recreational boating area. The state should evaluate the proposal to construct a deep-water terminal in lower Narragansett Bay in these terms and in the context of similar proposals for the Boston metropolitan area and the impact each has on the existing petroleum-receiving facilities and infrastructure. This kind of evaluation should proceed in light of the recommended Regional Port Development Study (see *Chapter 7 of the Regional Report*).

## SHELLFISH

The Narragansett Bay area abounds with a variety of shellfish. In some instances, overharvesting eliminated or seriously decreased the resource. However, at the present time, the major problem is pollution. Many productive areas are permanently closed to shellfishing while additional areas are temporarily closed due to periods of heavy rainfall and combined sewer overflows.

In 1971, there were 1,000 commercial shellfishing licenses sold, with a value exceeding \$13,000. No recreational license is required for resident shellfishermen, and consequently no reliable estimate is available for their numbers. However, since the number of license sales is not restricted, we can assume that the current demand for shellfishing is being met, although this does not mean that the experience is necessarily of high quality.

The quahog is the most important commercial shellfish in this area. Major concentrations are located in Narragansett Bay in the following areas: between Prudence Island and North Kingstown; between Bristol and Warwick; and between Portsmouth and Tiverton. From 1946 to 1961, the amount and value of quahogs harvested in Rhode Island has varied from a low of 178,000 bushels valued at almost a half million dollars to a high of 412,000 bushels valued at nearly \$2 million. Smaller, shallower areas in many of the bays and salt ponds are harvested by commercial and recreational diggers.

The closing of shellfish flats because of pollution, and the filling and dredging of estuaries and coastal marshes, are probably the two most important problems facing the shellfish industry in Narragansett Bay.

As is true throughout the SENE area, there are not enough shellfish resources within the planning area to satisfy the restaurant and market demand. Consequently, shellfish must be imported from other areas. It does appear, however, that recreational demands are being met.

The licensing of resident recreational diggers would provide additional revenue for research and management of Rhode Island's shellfish. In addition, a knowledge of the number and residency of the recreational diggers would indicate where pressure on this resource would be the greatest. This would help to determine where additional recreational areas should be provided.

Increased revenue for management of the resource will allow the state to survey shellfish areas and determine if they are being overfished or underfished. Management recommendations for opening or closing seasons on specific areas will then be based on recent factual information.

The fallacy of projecting demands upon shellfish resources is evident if one looks at projections in other fields. It is probably safe, however, to assume that the demand will increase at a percentage at least equal to the population growth. If this becomes the case, we can say that there will be enough areas to provide for recreational digging through 1990. In all probability, commercial digging will still not provide enough shellfish for the restaurant and market trade. Aquaculture, especially for oysters, may increase the commercial yield, but shellfish farming requires a large capital outlay and needs additional research. It is felt that most areas within the Bay are less suitable than potential South County estuaries.

In light of the above, the following recommendations are made:

- 5. Consider recreational shellfish licensing.**  
Rhode Island's Department of Natural Resources should consider implementing a pro-

gram of required recreational shellfish licensing for residents and visitors.

- 6. Eliminate combined sewer overflows in Providence.** The Department of Natural Resources should encourage the Environmental Protection Agency to provide funds to eliminate, or neutralize, the danger of pollution resulting from combined sewer overflows at the Providence treatment plant, so as to remove health hazards to shellfish beds in Narragansett Bay.

More detailed discussion of this recommendation is contained in *Chapter 5 of the Blackstone and Vicinity Planning Area Report*.

## OFFSHORE FISHERIES

The Narragansett Bay planning area contains two of the SENE region's five most active fishing ports: Point Judith-Galilee and Newport. The fishing industry of these ports contributes significantly to the state's economy, with the average 1969 through 1972 values running about \$11 million per year. This is second only to coastal recreation in terms of the financial value of transactions, and incorporates commercial activity in shellfish and finfish harvesting, frozen and fresh fish processing, and wholesale marketing operations.

Based on 1970 data, Washington County, whose principal port is Port Judith, is the major fishing county in the State of Rhode Island, with a volume of about 60 million pounds valued at \$5.0 million. For that year, Washington County represented nearly three quarters of Rhode Island's total volume, and over half the total value.

The total flounder catch, a high-value fish, amounted to 13 percent of the 1970 fish poundage, and 40 percent of its value. Comparing data for 1960 with that for 1970 reveals that total flounder landings have increased by 74 percent in volume, and 113 percent in value. Yellowtail flounder were predominant in this catch total. Unclassified fish, especially those for industrial use, showed significant volume in 1970 representing 53 percent of the county's total fish catch. Washington County's shellfish volume accounted for 39 percent of the state's total shellfish landings in 1970, and represented 45 percent of the state's gross ex-vessel revenue. The Northern lobster catch in 1970 represented 86 percent of the county's total shellfish value.

Virtually all remaining landings in Rhode Island are from Newport County, which provided 20 percent of Rhode Island's total fish landings, and 51 percent of the state's total fish value in 1970. Flounder accounted for over one-half of the county's annual finfish volume and value. Newport's

shellfish volume equalled 38 percent of Rhode Island shellfish poundage, with landings of 3 million pounds in 1970. The county's shellfish value of 2 million dollars represented 34 percent of the state's aggregate shellfish value. Northern lobster represents Newport County's predominant shellfish in both volume and value.

Between these two Narragansett Bay area fishing centers, the total percentage increase for Rhode Island from 1960-1972 was 14 percent in volume, and 218 percent in value. However, despite these local improvements, there are serious external pressures facing the fishing industry.

In 1961, the U. S. S. R. commenced exploratory fishing on Georges Bank, and by 1962 over 500 Soviet vessels were actively fishing for herring and groundfish. The success of the Soviet trawler fleet in 1961-1965 (480,000 metric tons in 1965) influenced the development of fleets in Poland, East Germany, and Romania, all of which appeared in the two years that followed. By 1968, Spain, Japan, and West Germany were also fishing off the U. S. Atlantic Coast and, more recently, Bulgaria, Greece, France, Italy, and Cuba have entered the fishery.

Utilizing advanced technology, numerical superiority, and persistence, the foreign fleets have become highly efficient competitors with our domestic fishing industry. Foreign overfishing has been blamed for declines of haddock, yellowtail, and herring on the historically productive fishing grounds of New England.

It is widely agreed that most traditionally fished stocks found off our Northeast coast are now harvested near or beyond their capacity to sustain themselves. It follows that any new potential to support growth should come from "underdeveloped" fisheries resources. And, in most cases, harvesting these species requires a financial risk, added fishing effort, plus new processing technology and marketing. Three abundant resources that are not fully utilized are offshore crabs, squid, and various mixed finfish species such as sea herring, dogfish, small silver hake, red hake, and butterfish. Many of these mixed species are now caught regularly, but are not brought ashore due to low market values. These caught, but unused, fish stocks have been estimated to be as much as 50 to 75 million pounds, or about 20 to 30 percent, of current trawl landings.

The New England Fisheries Development Program initially seeks to develop the three above-mentioned underutilized resources. It also will encourage new marketing techniques by the industry to take advantage of the increased consumer demand and to attempt to blunt the 70 percent share of the domestic market which foreign imports have captured. Two pilot plants, one in New Bedford, Massachusetts, and one in Point Judith, Rhode Island, have been processing two species of crabs, the Jonah and red crabs, with technical assistance from the New England Fisheries Development

Program. In the case of red crab, a ready market appears to exist. If new markets can be developed for these species, it would mean an economic boost to the industry. It has been estimated by fisheries development officials that an increase of one percent a year in landings for 10 years would mean perhaps another \$4.2 million to the fishermen and vessel owners.

The New England Fisheries Program is looking toward developing a method for handling mixed species catches of fish at sea, part of which may be used to make fish blocks. These are frozen blocks of fish flesh from which fish portions and sticks can be produced. Research is needed, too, to develop an automated system to process large quantities of small, irregular sized fish and to sort them into groups.

In light of the existing situation, the following actions are recommended:

- 7. Continue to support an interim offshore 200-mile economic zone.** Local fishermen and politicians should continue to urge the U. S. Congress to extend as soon as possible the nation's jurisdiction over fisheries to 200-miles offshore or to the edge of the continental shelf. This recommendation would provide better control over the offshore resource base as an interim measure, pending final proposals by the Law of the Sea Conference.
- 8. Support national fisheries management policy.** A national management policy should be locally supported by the fishing industry. The establishment of this joint federal-state management program would allow limited foreign entry, quota enforcement, seasonal or species control limitations, and fishing gear specifications within the 200-mile economic zone. The objective of the preceding actions would be to increase the supply and variety of fishery products without depleting stocks of any given species.
- 9. Improve market for underutilized fish species.** The local commercial fishing industry, with technical assistance from National Marine Fisheries Services under the New England Fisheries Development Program, should actively develop a domestic market for underutilized fish species by applying innovative marketing techniques in educating the public to the use of new fish stocks.
- 10. Accommodate coastal fish facilities through improved planning.** The coastal zone management program, in co-

operation with the Department of Community Affairs, should develop guidelines and provide technical assistance to local planning boards. Such assistance should be provided when making land use or zoning bylaws for shore-based support services for commercial fisheries, such as fish or shellfish processing plants, or updated docking and transshipment facilities. Such planning should also carefully consider Critical Environmental Areas (SENE Categories A and B) so as to protect those estuarine resources which are of vital importance to the commercially valuable offshore fisheries.

11. Allow privately financed purchase of foreign-built fishing vessels. Congress should consider repealing the law prohibiting the purchase and importation of foreign-built fishing vessels to allow their use specifically in depressed fisheries states if purchased with private capital. Federal monies should not be granted for purchase of such foreign vessels.

## OFFSHORE SAND AND GRAVEL

Although the rate of increase in demand for sand and gravel is beginning to slow as highway and building construction tapers off, the overall demand for these products can still be expected to increase in the next few decades. Although Rhode Island appears to have sufficient onshore sand and gravel deposits to meet its needs, the increasing transportation costs for these materials has made the extraction of offshore deposits more attractive.

Price increases of conventionally mined sand and gravel from June 1973 to June 1974 ranged from 10 to 50 percent in SENE, reaching as high as \$2.33 per ton in the Boston area. In contrast, industry experts now estimate that by 1976 far-shore sand and gravel could be extracted, processed, and delivered dockside at \$1.00 per ton. Adding transportation to this dockside cost, far-shore sand and gravel could be competitive up to 30 to 40 miles inland from port of entry.

The degree to which offshore sand and gravel mining affects the marine environment varies considerably by site. Some effects are known to be minor and temporary, others major and permanent, while for others little is known. Three areas of potential conflict exist: fisheries, recreation, navigation, and communications.

Given the importance of both the commercial and sport fishing industries to the SENE region, offshore mining will require careful scrutiny and more information than is presently available. From the research which has been done to date, it appears that if mining is restricted to far-shore waters, away from near-shore shellfish beds and delicate spawning grounds, detrimental effects to the fisheries would be minimal (*see Chapter 7, Regional Report*).

The mining industry appears to have anticipated these problems and has focused its attention and development on far-shore mining. In addition to the need to reduce conflicts with other uses, the industry is interested in far-shore mining because: (1) far-shore waters currently lie outside state jurisdiction; (2) ocean transport costs are low; and (3) recent technological developments have significantly increased the efficiency of mining in depths exceeding 100 feet (*see Offshore Sand and Gravel Extraction in Chapter 7 of the Regional Report*).

In light of the direct relationship between the closeness of mineral extraction to shore and potential environmental damage, it is in the best economic and environmental interests of the SENE region for the states to regulate near-shore mineral extraction. The SENE Study recommendations on offshore sand and gravel mining can be found in *Chapter 7 of the Regional Report*. The recommendations are designed to support the far-shore mining operator, should such extraction be needed, by providing sensitive site selection mechanisms and clear operating criteria and regulations. By clarifying operating standards and identifying approved extraction sites, the program of recommendations provides opportunities for extraction while being sensitive to the importance of these same far-shore waters to the region's fishing industry.

## URBAN WATERFRONTS

Urban waterfront issues in major coastal and riverfront cities in the region have been discussed in a separate special report prepared for the SENE Study — *the Urban Waters Special Study*. One city in the planning area — Newport — is included in the report. Two other cities — Providence and East Providence, which are in the Blackstone planning area — are included because of their location at the head of Narragansett Bay.

New England's waterfront cities were largely responsible for the area's rapid economic growth and development in the eighteenth and nineteenth centuries. As noted in New York's "Waterfront Workshop" conducted by the City's Planning Commission in 1974:

"Time and technology have left stranded many once-

busy segments of the waterfront. Brickyards, stoneyards, lumberyards, and coal terminals have either gone out of business or moved elsewhere. Containerization has shifted the volume of shipping business, and airlines and cruises have transformed passenger ship piers.

"These changes have opened up the waterfront's potential, although in a double-edged fashion: because one type of development usually precludes all other alternatives, proposals may generate counter-proposals. A housing plan is met with the suggestion that a park would be preferable, a plan to site industry may arouse environmentalists, a plan to turn over an idle pier for recreation may be attacked as a blow at shipping. Almost everyone agrees that the shoreline is too valuable to be allowed to lie fallow, but agreement on a specific plan may be difficult to obtain. This is one of many contradictions enshrouding the waterfront."

In order to recapture the vitality which lies just beneath the surface of decay and neglect, a few institutional and administrative changes are needed, backed by public awareness. Several cities and towns have initiated or carried out sound programs for waterfront development or renewal, although their success has often occurred in spite of, rather than because of, current institutional public policy.

Industrial uses dominate the Providence waterfront, particularly petroleum related docks and storage along the western shore south to Field's Point. Electric power plants and the Fox Point Hurricane Barrier also highlight the waterfront. In recent years, interest in the historic and recreation potential of the Providence waterfront has spurred redevelopment of the historic area at the foot of College Hill and the development of India Point Park. Opportunities for increased recreational use of, or public access to, the shoreline exist along the Seekonk River, from the India Point Park to Blackstone Park and possibly beyond that point.

Across the Providence and Seekonk Rivers from Providence is East Providence where the primary waterfront use is petroleum import, storage, and transfer. At one time the East Providence waterfront was intensively used for marine facilities, but as coastal shipping decreased the waterfront declined. As in Providence, the hurricane of 1954 had a devastating impact on the remaining activities. Renewed interest in waterfront property for commercial, recreation, and high-density residential uses has been slow. Current issues include landfill and clean-up proposals, upgrading or abandoning the line along the waterfront, reuse of large parcels of land, and development of the Boyden Heights Conservation Area.

Uses of Newport's waterfront include shipyards, marinas, commercial fishing facilities, and water-oriented retail businesses such as restaurants and shops. In addition,

luxury housing is being built near the waterfront. Newport is reorienting toward tourist and water-related commercial, recreation, and residential development to compensate for the Navy base closure. Renewal projects have included new shipping and office space, hotels and housing, and the widening and construction of roads adjacent to the waterfront.

By integrating master planning and development control functions in urban waterfront areas, local governments can focus public interest and concern on relevant development issues and establish administrative framework at the local level.

In the light of the previously discussed options, the following actions are recommended in order to enhance the reuse of urban waterfronts in a rational and balanced manner.

**12. Coordinate local waterfront planning and development.** Municipalities should prepare and inventory or plan for the long-term use or reuse of waterfront areas. In undertaking such activities, towns should give special consideration to factors such as the protection of flood prone areas, the preservation and enhancement of historic sites and buildings, the provision of public access easements (both physical and visual) in new development, building height, and so forth, consistent with Critical Environmental Areas (*as specified in Chapter 3, Guiding Growth*).

**13. Provide public waterfront vantage points.** Municipalities should provide safe, public vantage points at strategic waterfront locations for recreation and appreciation of the visible attractive commercial and industrial activities.

While primary responsibility for initiating and carrying out land use decisions should remain at the local level, the state should perform the following functions:

**14. Provide guidance and set criteria at the state level for priority waterfront uses.** Massachusetts and Rhode Island, through their coastal zone management programs or state land use planning programs, should develop urban waterfront planning and management guidelines, and criteria for deciding priorities for uses to be incorporated into local waterfront master plans. Priorities should be established for water-dependent uses, water-using uses, complementary uses, and low-priority uses.

**15. Review and coordinate waterfront use.**

Massachusetts, through its regional planning agencies, and Rhode Island, through its State-wide Planning Program and Department of Community Affairs, should exercise their powers to review and revise major waterfront development proposals of more than local concern.

**16. Provide federal funding support for state and local waterfront development plans.**

The U. S. Congress and the Office of Management and Budget should approve adequate federal funding for state coastal zone planning programs and

**for other planning programs which enhance waterfront redevelopment.**

Implementation of coordinated local and state approaches to waterfront use should help to minimize fragmentation of decisions in waterfront areas while recognizing the appropriate roles of the different levels of government. Agreement on appropriate guidelines and priorities should help to reduce conflicts between uses, and increase the chances for a variety of uses along urban waterfronts.

More sensitive and sensible use of waterfronts will reinforce use of existing infrastructure and help to reutilize urban areas which have considerable economic and aesthetic potential.

## CHAPTER 8 FLOODING AND EROSION

In the Narragansett Bay planning area, where the topography is flat, the flood plains are broad relative to the size of the streams and can adequately modify flood flows, thereby reducing flood stages. As a result, inland flooding damages in this area have been minimal. With increasing development in flood plain areas and loss of existing natural valley storage areas, however, flooding in and around the Bay could become more frequent and serious. Tidal flooding has been more frequent, with some serious damage, particularly during the 1938 and 1954 hurricanes. Critical erosion, totalling 35,200 linear feet per year, occurs at three points within the planning area, especially on Block Island. No other planning area but Cape Cod and the Islands exceeds this total.

### The Situation

#### Inland Flooding

Flood damage is not significant in the non-tidal portions of the coastal streams because of the availability of open floodway areas, abundance of wetlands which provide significant natural valley storage, and low development density. Thus, damages in this planning area resulting from a storm which equivalent to a 100-year frequency event would probably not exceed \$100,000 under present conditions. However, as development continues to occur in the basin, the extent of these damages is expected to increase. Nuisance flooding is confined to Middletown (where occasional flooding in Paradise Brook, Mainford Brook, and Bailey Brook affects a total of 12 residences) and to several areas in North Kingstown. Approximate flood plain areas (100-year frequency storm) total 20,880 acres.

Small industrial dams still exist along several Narragansett Bay streams. However, they were not designed to be capable of storing excess floodwaters, and are normally open during high water periods.

Wetlands total 23,200 acres — 20,800 acres of fresh water wetlands and 2,400 acres of salt water wetlands — and make up some 11.5 percent of the planning area. Extensive wetlands in the West Bay towns of Narragansett, North Kingstown, and East Greenwich are important for both flood flow regulation and production of fish and wildlife resources. Swansea, Tiverton, Little Compton, Rehoboth, Bristol, Warren, and Barrington have sufficient natural valley storage areas and largely undeveloped flood plains to minimize flood damage costs. The greatest amount of wetland area is in the more undeveloped towns of Little Compton, Rehoboth, Swansea, and Tiverton.

#### Coastal Flooding

Tidal flooding from hurricanes occurs at irregular intervals, but these storms are not uncommon to the area. Records indicate that at least 71 hurricanes have affected, or threatened, the Bay since 1635 (62 since 1800). Thirteen of these caused severe tidal flooding. In addition to the hurricanes, a large number of other storms occur in the area. These include extra-tropical storms and northeasters. The Bay is relatively protected from the frequent winter northeasters, but such storms can be stalled in the area for several days and cause higher tides than normal over a longer period of time. Approximate tidal flood areas (100-year frequency storm) total some 20,200 acres. Areas identified by the Corps of Engineers as coastal damage centers are Mount Hope Bay, Newport Harbor, Warren River, Greenwich Bay, and Wickford Harbor.

The two most destructive recent storms were those of September 21, 1938, which caused tidal flooding in the Bay to elevations ranging from 10.8 feet above mean sea level at Newport, to 15.7 feet above at Providence; and August 31, 1954, which caused flooding to a stage about one foot below the 1938 level. There are no firm estimated tidal flood losses from the 1938 hurricane. However, Hurricane Carol in 1954 left in its wake a total loss of \$92 million from tidal flooding in Narragansett and Mount Hope Bays. Total experienced flood losses below the Fox Point area were \$11 million along the west shore of Providence; \$28 million from Cranston to Narragansett; \$23 million on the east side of the Bay from Providence to Sakonnet Point, including the Mount Hope Bay area, of which \$923,000 was along the Sakonnet River below Island Park.

A plan that would have provided a reduction in hurricane flood levels in the planning area was published by the Corps of Engineers in 1966. The report was an interim hurricane survey of the Narragansett Bay area, including the Mount Hope Bay area, in Rhode Island and Massachusetts. It provided for the construction of ungated rock barriers across the lower portions of each of the East and West Passages to Narragansett Bay, and one across the upper end of the Sakonnet River tidal arm, with supplemental dikes at low lying land areas. The plan was designed to reduce the 1938 flood level by 7.7 feet at Providence and a proportional amount for hurricane tidal floods of different magnitudes. The overall project was estimated in 1966 to cost \$90 million. The project was unfavorably received because of local concern that the barriers would be detrimental to navigation and the ecology of the Bay, and because of a reluctance on the part of the two states to meet the funding share required by the plan.

Other areas of damage within the Bay were also studied. However, in most cases the cost of protection was more than the estimated benefits, and a report on the Rhode Island coastal area was published by the Corps of Engineers in 1967, describing methods of protection that could be undertaken by individual property owners and other local interests.

Tidal flooding is still a serious problem in the Narragansett Bay area. In a recurrence of the August 1954 hurricane flood stages, the Fox Point Hurricane Barrier in Providence would prevent an estimated \$59 million in damages, leaving a damage potential of about \$110 million in the Narragansett Bay area.

The Corps of Engineers is presently conducting a comprehensive flood management study of the Pawcatuck-Narragansett Bay (PNB) area. Authorized following the severe storm of March 1968, the study will include detailed evaluation and recommendations for controlling future flood damages in the Bay area. The study will consist of detailed damage surveys to determine the extent and location of the most serious damage under present conditions. These data will be evaluated according to the full range of economic, environmental, and social criteria. During the course of the study, work will be carried out in cooperation with state and local officials. Various measures for reduction of potential tidal flood losses at damage centers will be investigated, including local protection projects and non-structural solutions where feasible, especially for coastal damage centers of Newport, Mount Hope Bay, Warren River, Greenwich Bay, and Wickford Harbor. (Point Judith is not in the PNB area.)

The 1964 Corps of Engineers coastal survey report discussed earlier concluded that no further federally supported structural protection projects could be justified at the time. In fact, one project — the Point Judith multi-purpose project — authorized in 1962 at an estimated (1962) cost of \$7.4 million, is being considered for deauthorization by the Corps of Engineers. A feasibility study for just navigation improvements, without hurricane flood and erosion protection, is now underway. The Narragansett Pier Project, authorized in 1962 at an estimated cost of \$3.5 million, was deauthorized in 1970.

The Soil Conservation Service (U. S. Department of Agriculture), and other cooperating agencies are sponsoring the Rhode Island Resource Conservation and Development (RC&D) Project. This project is locally initiated and directed, and is designed to carry out a program of land conservation and land utilization, accelerated economic development and employment. The project is considering, among other things, three small flood prevention projects in Middletown, Portsmouth, and Tiverton.

## Upland and Coastal Erosion

**Upland Erosion.** Upland erosion is more serious in the Narragansett area than any other of the SENE Study planning areas. There are erosion problems on approximately 4,000 acres of cropland and 6,000 acres of urban lands or lands undergoing urban development. The towns of Little Compton, Middletown, Portsmouth, and Tiverton have the most serious erosion problems on agricultural lands. The municipalities of Middletown, North Kingstown, and Warwick have the most serious urban erosion problems.

For the agricultural lands in the basin, technical assistance for conservation land treatment practices is available from the local Conservation District. Much of the erosion damages can be avoided through a sound urban-environmental forestry program to retain as much of the native vegetation as possible.

**Coastal Erosion.** Coastal storms and the effects of wind, fresh water runoff, and wave action combine to cause losses of beaches, high bluffs, or dunes in some areas. Critical coastal erosion of 3 feet or more per year occurs in Warwick (1,800 feet), Narragansett (2,400 feet), the Block Island (31,000 feet) — a total of 35,200 linear feet.

Because of lack of local support of the Narragansett Pier multi-purpose project, the beach nourishment portion of the project was included in the deauthorization, leaving the beach subject to continuing critical coastal erosion of 3 feet or more per year. This rate of erosion is significant, reducing the capacity of the beach to meet regional recreation demands. Unless steps are taken to control this erosion, other beaches will have to become more important in meeting regional needs.

Studies of Conimicut Point Beach and Oakland Beach, both in Warwick, were requested by the City of Warwick in September 1973; a feasibility report for both beaches is now in progress by the Corps of Engineers. No other beaches in this study area have been the subject of a Corps of Engineers report. Local, private, and public interests have periodically maintained their beaches to the best of their ability and funds, as required.

The Cliff Walk coastal erosion control project in Newport provided for construction of improvements for shore protection along 3.5 miles of the coast and consisted of intermittent reaches of backfill, dumped riprap, stone mounds, slope revetment, concrete toe walls, seawalls, parapet walls, grading, surfacing Cliff Walk, and providing drainage. About 1.8 miles of the project were completed in September 1972 at a cost of \$1.25 million with local sources providing nearly 80 percent of the funds; another estimated \$.58 million (1972 estimate) is needed to complete the remaining 1.7 miles.



## The Solutions

### Recommendations

A major result of the SENE Study has been the classification of the region's resources according to their capability. Inland and coastal wetlands, estuaries, beaches, barrier beaches and critical coastal erosion areas have been classified as "A" resources, requiring the greatest degree of protection from development. Flood plains and hazardous coastal flooding areas (both to the 100-year flood frequency line) have been classified as "B" resources or management areas which have very limited tolerance for development, but with proper management are suitable for such compatible activities as agriculture or recreation.

In keeping with these resource classifications, it has been recommended that comprehensive flood plain management programs be prepared for flood prone areas, making use of non-structural solutions wherever possible. All such programs should be developed in close cooperation between federal and state agencies, and local governments and interests. They should also be coordinated with related programs, such as the National Flood Insurance Program, forecasting services of the National Weather Service, state wetlands acts, state land use planning programs, and for coastal areas, with the state coastal zone management program.

Two important programs are now ongoing which cover the Narragansett Bay planning area. Through the PNB Study, the Corps of Engineers is authorized to investigate means for reducing flood damages. The Soil Conservation Service and a number of Rhode Island agencies and groups are sponsoring the Rhode Island RC&D project, which among other things, provides for consideration of flood protection projects.

Section 73 of the Water Resources Development Act of 1974 authorizes federal cost sharing for non-structural measures. Although implementation of Section 73 has presently been deferred by OMB (Office of Management and Budget), application of the cost sharing authority can be an important factor in making non-structural solutions more competitive than they have been.

Therefore,

1. **Develop flood plain management programs which maximize non-structural solutions.** The Corps of Engineers, Soil Conservation Service, and other sponsoring and participating agencies should reconsider preliminary findings of the PNB and RC&D projects in order to reassess the long-term viability and efficiency of non-structural solutions due to potential cost sharing provisions of Section 73.

Both programs should include consideration of regulation of existing dams, bridge and culvert reconstruction, and improved and expanded storm and flood forecasting and warning services, which together may prove to be viable alternatives to large structures.

In coordination with the PNB, RC&D, and the state coastal zone management program:

2. **Adopt local flood plain zoning preventing adverse flood plain development.** Municipalities should adopt flood plain zoning to prevent adverse development in flood prone areas (and particularly in the 100-year floodway) as defined under the National Flood Insurance Program.

This also includes incorporating inland and coastal wetlands, critical coastal erosion areas, beaches, barrier beaches, and storms of record on the map upon which the zoning is based. All related regulation — building codes, subdivision regulations, sanitary codes — should reinforce this policy of preventing adverse development and redevelopment in the 100-year flood plain. The regulations should also take advantage of the restrictive provisions of state wetlands regulation, scenic rivers programs, and the like. Technical assistance should be provided to all officials responsible for enforcing the zoning and related regulations.

Related to local zoning action are two recommendations for controlling local sedimentation and inland erosion problems.

3. **Establish local sediment and erosion control ordinances.** Municipalities, assisted by the U. S. Department of Agriculture and the Department of Natural Resources should establish local sediment and erosion control ordinances.

A model for such ordinances is included in the more detailed information prepared for the Study and is available in the NERBC files.

4. **Establish forest buffer zones.** Municipalities should establish appropriate forest buffer zones within 200 feet of streams and lakes to preserve vegetation and maintain natural systems through forestry techniques to help keep non-point source pollutants from reaching sensitive water quality areas.

Towns with existing high and medium development pressure such as Narragansett, North Kingstown, East Greenwich, and Warwick on the West Bay (see Chapter 3, Guiding Growth), should be among the first to implement these two recommendations.

5. Establish local regulations to strengthen flood plain management. Municipalities should ensure that all local regulations, including building and sanitary codes, reinforce the intent of the zoning districts and regulations recommended above.

In conjunction with a flood plain zoning program:

6. Acquire significant flood plains and wetlands. Municipalities and state agencies should investigate continuing possibilities to acquire those wetlands and flood plain areas most significant for flood damage reduction and protection, and which have water supply, wildlife and/or recreation values.

Particular emphasis should be given to protection of areas classified as unique natural areas and those located in areas subject to high and medium-high development pressure not already under public or semi-public ownership. Areas which should receive priority attention include:

- extensive wetlands in Little Compton, Rehoboth, Swansea, and Tiverton;
- wetlands in Narragansett and North Kingstown (especially along the Pettaquamscutt River and where wetlands also have important wildlife values) and in Portsmouth (especially the north end of Prudence Island) and Warwick, all four of which are already subject to high development pressure

Many wetlands in Rehoboth, Swansea, Barrington, and Warren also have water supply and wildlife values. Additional approaches to protecting wetlands are included in *Chapter 8 of the Regional Report*. Protection of wetlands and flood plains is also expected to help existing flood protection projects do their job by keeping flood flows to within the design capacity of the existing channels.

In built-up and heavily used areas such as Newport or Warren, alternative locations outside the flood plain may not be feasible.

7. Locate in existing safe buildings in the flood plain. Where location outside the flood plain is not feasible, municipalities should encourage private interests to locate

in existing safe buildings in the flood plain, rather than permit new construction in the flood plain.

Floodproofing, especially of existing buildings, is particularly appropriate where only moderate flooding is expected, where other types of flood protection are not feasible, or where activities in waterfront locations need some degree of protection. In many instances, essential new waterfront facilities may have to be constructed so that their docks and materials handling areas are well above present levels. Improved and expanded storm and flood forecasting and warning services, recommended in *Chapter 8 of the Regional Report*, will also be important in keeping down future damage costs.

The *Regional Report*, *Chapter 8*, recommended including critical erosion areas in 100-year coastal flood prone areas and putting the entire area subject to coastal flooding under the jurisdiction of the Coastal Resources Management Council. On a local level, recommendation number 2 called for prohibiting development and other damaging uses of critical erosion areas through local flood plain zoning. In addition, municipalities should:

8. Encourage natural stabilization of coastal erosion areas. Municipalities and conservation commissions should continue to encourage stabilization of critical coastal erosion areas.

Use of vegetative cover, snow fences, discarded Christmas trees, and boardwalks have proven effective approaches to control accelerating rates of wind and wave erosion. Additional details for municipal protection of barrier beaches are included in the University of Rhode Island, Coastal Resources Center's two-volume *Barrier Beach* report.

No specific sites have been identified for structural erosion control projects in this planning area. However, *Chapter 8 of the Regional Report* recommends selective construction of erosion control projects for areas other than beaches such as eroding bluffs (except for unique natural sites such as Mohegan Bluffs on Block Island). Artificial beach nourishment does not provide substantial benefits unless public recreational benefits are added in as well. Therefore, further discussion of the possibilities for beach nourishment are included in *Chapter 6 of this report*. Any studies and projects should address the littoral drift relationships between beach erosion and headland protection.

## Implications

This approach is a good deal more restrictive than the National Flood Insurance Program requires. But it does make full recognition of resource limitations and natural

functions of wetland and flood plain areas. The SENE Study has found that all new development can be accommodated in C, F, and G lands (*as discussed in Chapter 3, Guiding Growth*), so that protecting A and B lands from inappropriate use need not be incompatible with a

growing economy. In fact, a policy of resource protection and non-structural solutions is regarded as a significant step toward protecting the physical beauty of the region's landscape which is expected to be in the long-term economic interest of the SENE region.

## CHAPTER 9 LOCATING KEY FACILITIES

One of the most difficult subjects to grapple with at the local level is the siting and operation of such key facilities as power plants, sand and gravel pits, and petroleum refining, distribution, and storage sites. Bluntly stated, they are unwelcome neighbors. At the same time, however, few people are willing to live with the consequences of not having enough of the vital products or services provided by these operations. The situation is further complicated by increasing competition from other potential users of the sites which could be used for key facilities.

While discussion of these issues is more appropriately approached from a regional perspective and is discussed in detail in *Chapter 9 of the Regional Report*, there is some merit in investigating the situation within individual planning areas.

### SAND AND GRAVEL MINING

The 1964 Rhode Island construction aggregate survey indicates the reserves of sand and gravel in the Rhode Island portion of the Narragansett Bay planning area totalled 8.1 million cubic yards. However, due to the heavy urbanization of these towns, it is unlikely that the total reserve will ever be mined.

Ten sand and gravel producers are active in the planning area: two each in Swansea and Seekonk, Massachusetts; and one each in East Greenwich, East Providence, Middletown, North Kingstown, South Kingstown, and Portsmouth, Rhode Island. Substantial amounts of sand and gravel are trucked from a site in Warwick to a processing plant in the Pawtuxet planning area. Crushed stone is quarried in Middletown. Total output from sand and gravel production in the planning area in 1970 was 900,000 short tons, and was valued at approximately \$1.3 million.

Extraction regulations, viewed by the producers as unduly restrictive, are in fact quite weak from a resource protection point of view. In the Narragansett Bay planning area, towns generally impose one year time limits on permits with permit violation fines ranging from \$20 to \$200. Operators are faced with a difficult dilemma: on the one hand they are restricted from mining many developable sites by town ordinance or preemptive uses, while on the other hand, they receive little guidance for operating those sites for which permits have been granted.

Whether the existing pattern of creeping suburbanization currently being experienced within and on the fringes of the planning area is permitted to continue, or the growth

of the surrounding region is guided to areas where municipal services already exist or can be readily expanded, the planning area's sand and gravel deposits will be vitally needed.

Alternatives to solve the sand and gravel production issue, discussed more fully in *Chapter 9 of the Regional Report*, are limited. Processed products can be imported from outside the planning area but only at astronomical transportation costs. The implications of such costs could drastically worsen the condition of the already sagging construction industry. Furthermore, the chances are that the availability of aggregate is really no better in other areas. Considerable potential exists in obtaining sand and gravel from offshore deposits, but this appears to be a long-range alternative. The only currently environmentally and economically feasible alternative is development of a state and local system of sequential land uses.

Rigorously pursued, the recommendations made for each state in *Chapter 9, of the Regional Report* will be sufficient to guarantee the protection of significant mineral deposit sites and regulate extraction operations in the Bay area. Specifically, the recommendations provide for state-established operating standards under a local land use approval system, provides a standard permitting procedure for all extraction operations, and guarantees site reclamation. Moreover, for the Massachusetts portion of the planning area, the recommendations provide for a mineral survey to at least match the survey already conducted by Rhode Island. With sites identified, a system of sequential uses of mineral deposit lands established, and strong regulations for operations and reclamation, adequate sand and gravel can be produced to meet the planning area's needs at the least economic and environmental cost to residents. The program will be more than adequate to meet projected needs until the viability of alternative measures can be established.

### POWER GENERATION AND POWER PLANT SITING

The Narragansett Bay planning area contains almost 27 percent (1445.7 megawatts) of the total installed capacity in the Southeastern New England area. It also boasts the largest thermal plant (Brayton Point in Somerset on Mount Hope Bay). All of the planning area's plants are coastal and utilize once-through saline cooling systems. There are no major power facilities inland because there are no fresh water courses with adequate and dependable water supplies for cooling.

Construction is underway at Brayton Point on a fourth unit with an installed capacity of 437 megawatts. This unit, to conform with the new water standards and environmental controls, will include the first salt water spray cooling device in the SENE region to minimize thermal discharge.

Narragansett Electric, an operating subsidiary of the New England Electric System, one of four private utilities operating the area, has presently discontinued consideration of a nuclear unit at Rome Point, and is preparing an application for at least two, possibly four, 1200 megawatt nuclear generators at the site of the former Charlestown Naval Air Station within the Pawcatuck planning area. The state has commissioned the University of Rhode Island's Coastal Resources Center to undertake a \$30,000 study of the impact of the proposed facility (*See discussion in the Pawcatuck planning area report.*)

The University of Rhode Island, in a study of 33 potential sites, concluded that every site had "significant siting problems" (including the Charlestown site). Yet the coastal zone in Narragansett Bay continues to have suitability for power plant siting. Clearly, if this area is to continue to be a major power generator center for the region, significant tradeoffs between economic and environmental factors will be necessary. The alternatives to this kind of decision making — a significant demand reduction (*discussed in Chapter 9 of the Regional Report*) and alternative energy sources — appear feasible only in the mid- to long-term.

Recommendations listed and explained in the Regional Report will be sufficient to manage the siting of power plants in the Bay area. The existence of a detailed power plant siting study for the planning area should, taken with the recommendations of this Study, assure the sound siting of future generation facilities in a manner which will enhance the economy of the region without significantly damaging the environment upon which much of the Bay's economy is based.

## **PETROLEUM REFINING DISTRIBUTION AND STORAGE**

The existence of a deepwater channel and the ready availability of industrially zoned potential development land has made the Bay a prime prospect for oil refining and storage in recent years.

Vociferous opposition defeated a Northeast Petroleum bid to site a refinery in Tiverton, but the availability of surplus Navy land has rekindled interest. At last count, Melville, Quonset, Prudence Island (surplus Navy facilities), and

Jamestown were all being considered by private developers as potential refinery sites. Furthermore, developers are conducting feasibility studies on a site just south of Gould Island in the East Passage north of Newport Bridge to serve as a central receiving port for deep draft petroleum tankers. And an inland site in Exeter and North Kingstown, together three other sites, are being considered as potential oil refinery sites.

While this Study has not investigated the refinery siting question in the Bay in any detail, it is quite clear that with the possible exception of the Melville site, such activities are in direct conflict with proposals that the Bay islands be preserved as a regionally significant recreation area of major economic importance. Extremely stringent restrictions will need to be placed on petroleum facility developers to assure the continued high quality of the Bay, restrictions which may well prove prohibitively costly at the present level of control technology. Furthermore, the Study has developed no information, either in support of, or in opposition to, suggestions that the southern end of the Bay become a "supertanker" port. The Study agrees with the argument that decreases in small tanker traffic resulting from the use of "supertankers" should reduce the likelihood of damaging oil spills. At the same time, however, it is also Study policy that such deepwater ports should be located well offshore, and only after detailed study, to minimize onshore environmental effects.

While the Environmental Protection Agency (EPA) has developed criteria for petroleum facilities siting, and both the New England Regional Commission and the Federal Regional Council (FRC) are in the process of developing siting guidelines for the New England region, the major responsibility for site selection remains at the state and, ultimately, the local level.

In light of the significant tradeoffs in siting either refineries or a receiving terminal in the Bay, it is the conclusion of the Study that the best interests of the people of Rhode Island would be served by postponing considerations of specific facilities sites until the regional policy implications of the New England Regional Commission's energy facilities siting study have been determined by the New England governors. If, as a result of that determination, Narragansett Bay is still considered a feasible alternative, the state should establish strict facilities siting standards and operating regulations consistent with the recommendations detailed in *Chapter 9 of the Regional Report*.

## **SOLID WASTE MANAGEMENT**

Finding a way to dispose of the tremendous amount of solid waste generated daily is a particularly perplexing problem for the Narragansett Bay area with mounting and competing

pressures on remaining undeveloped lands. Although a bond issue was defeated in the 1974 elections, the Solid Waste Management Corporation is seeking funding for the next phase of planning. *Chapter 9 of the Regional Report* recommends funding support for the Corporation and urges community

participation. In the interim, proper enforcement of existing sanitary landfill regulations is expected to do much to reduce the negative effects on water quality and the natural landscape such activities can have.

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